Chapter 9

Summary/ Nederlandse samenvatting
Summary

It is generally acknowledged that an estimated 10% of all women during their reproductive years are affected by endometriosis. Various theories have been promulgated to explain the pathogenesis of endometriosis, but the “retrograde menstruation theory” postulated by Sampson in 1927 is still the most widely accepted. However, not all women with “retrograde menstruation” develop endometriosis and the theory cannot explain all locations of endometriotic lesions. Therefore, the origin of endometriosis remains a continuing debate.

There is a significant diagnostic delay of endometriosis, because symptoms are not easily recognized and a non-invasive test for diagnosis is not available. The gold standard for diagnosis of pelvic endometriosis is visual inspection by laparoscopy. However, laparoscopy is limited for the evaluation of deep infiltrating endometriosis (DIE) as patients diagnosed with DIE often show extensive pelvic adhesions. Also, the infiltration depth and extent of DIE lesions infiltrating under the peritoneum cannot be evaluated. Therefore, imaging techniques are necessary for mapping of disease extent. Accurate assessment is helpful to decide whether surgical intervention is indicated and to choose an adequate surgical technique. Transvaginal sonography (TVS) and magnetic resonance (MR) imaging are both used for the evaluation of endometriosis. TVS is often used for screening and MR imaging is in general performed in patients referred, because of suspected DIE.

In chapter 2 we assessed the value of MR imaging in diagnosis of endometriosis infiltrating the muscular layer of the bowel wall. MR imaging findings were correlated to histopathology. Lesions showing muscular infiltration at histopathology demonstrated a fan shaped configuration with hypointense signal intensity on T2-weighted MR imaging. The fan shaped configuration correlated with thickening of the muscularis at histopathology as a consequence of infiltration of endometriosis into this layer of the bowel wall. In all lesions with endometriosis infiltrating the muscular layer of the bowel, also thickening of the submucosa was found, recognized by hyperintense signal intensity at the luminal side of the bowel wall on T2-weighted MR imaging. Thickening of the submucosa is probably caused by edema and is not specific for infiltration of
endometriosis into this layer, but may be caused by underlying endometriosis. In patients who underwent segmental bowel resection, the sensitivity, specificity and accuracy for diagnosis of infiltration of the muscular layer of the bowel wall on MR imaging were 100%, 75% and 96%.

Chapter 3 shows MR imaging in deep infiltrating endometriosis (DIE) of the bladder. The purpose of this study was to describe MR imaging findings in bladder endometriosis and to assess involvement of the anterior uterine wall, to improve diagnosis and help explain the pathogenesis. In most cases DIE lesions infiltrating the bladder demonstrated homogeneous or heterogeneous isointense signal intensity compared to muscle on T2- and fat-suppressed T1-weighted MR imaging. The heterogeneous aspect on T2-weighted imaging was caused by foci of high signal intensity, indicating dilated endometrial glands and on T1-weighted imaging by foci or small cysts demonstrating high signal intensity, indicating haemorrhage. In almost all cases the anterior uterine wall was involved in DIE infiltrating the bladder wall. This supports the hypothesis that postoperative recurrences may develop from uterine foci. Uterine lesions that showed continuity with bladder endometriosis demonstrated hypointense signal intensity with ill defined borders. In contrast to adenomyosis, they do not extend to the junctional zone in general, and should therefore not be diagnosed as “adenomyosis” in our opinion. An explanation for uterine involvement in endometriosis infiltrating the bladder wall, may be the seeding theory, which states endometriosis develops secondary to intraperitoneal seeding of endometrial cells.

The purpose of chapter 4 was to describe MR imaging findings in abdominal wall endometriosis (AWE) and evaluate the role of MR imaging. In most cases, lesions were located ventral or dorsal to the aponeurosis of the rectus oblique muscle or in the rectus abdominis. In one extraordinary case an endometriotic lesion, both cystic and solid, was located in a herniation of the abdominal wall. AWE lesions showed a standard MR imaging appearance, depicting hypointense signal intensity compared to muscle on T2-weighted imaging and slightly hyperintense signal on T1-weighted imaging with or without foci of high signal intensity on T2- or T1-weighted imaging. Abdominal wall endometriosis is primarily treated
by hormonal therapy, but if this does not relieve symptoms, a surgical approach may be chosen. Regarding surgery, complete excision is recommended to prevent recurrence. MR imaging may be valuable for diagnosis of AWE and to assess extension of lesions to surrounding tissues preoperative to surgery.

Chapter 5 provides a study to evaluate the use of diffusion-weighted MR imaging in the standard MR imaging protocol for (deep infiltrating) endometriosis. We demonstrated ADC (apparent diffusion coefficient) values in DIE are consistently low and did not show a significant difference between pelvic locations. DIE lesions demonstrated low signal intensity on high $b$-value diffusion weighted images, and with concomitant low ADC values, this indicates restricted diffusion. Restriction diffusion in DIE lesions may be explained by fibrosis and smooth muscle components present at histopathology in deep infiltrating endometriotic lesions. ADC values of endometrial cysts, demonstrating hypointense signal intensity (shading) on T2-weighted MR imaging, were calculated and compared to T2SI (signal intensity lesion/signal intensity muscle) ratios. We found a high correlation between ADC values and T2SI ratios in endometrial cysts and hypothesized that diffusion-weighted imaging may have no additional value in the differentiation between endometrial cysts and other ovarian cysts.

In chapter 6 the value of MR diffusion-weighted imaging is assessed to differentiate between endometriosis infiltrating the bowel and colorectal carcinoma. In most patients, differentiation between DIE infiltrating the bowel and colorectal carcinoma is facilitated by clinical and imaging features. Occasionally, clinical features are not specific and imaging techniques performed may not show characteristic signs. In this study endometriosis infiltrating the bowel was found to show consistent low signal intensity on high $b$-value diffusion-weighted images, probably caused by fibrosis and smooth muscle, whereas colorectal carcinoma showed high signal intensity on high $b$-value images in all lesions, as a consequence of a high cellularity of these lesions. Therefore we concluded, MR diffusion-weighted imaging may be used, in addition to conventional MR imaging to help differentiate endometriosis infiltrating the bowel and colorectal carcinoma.
In chapter 7 we focussed on the value of a recently introduced sequence, 3DT2-weighted MR imaging (SPACE). The 3DT2-weighted sequence combines highly resolved 3D datasets with high soft tissue contrast and has the advantage of retrospective free alignments of images according to anatomic/pathologic structures. In this study, 3D and 2DT2-weighted MR imaging was performed in patients referred for suspected endometriosis infiltrating the bowel. Two readers independently assessed both datasets for presence of deep infiltrating endometriosis located retrocervical and involving the bladder or bowel, artefacts and image quality. If it is possible to achieve similar image quality and diagnostic performance in endometriosis, using 3DT2 SPACE compared to 2DT2 sequences, the latter may be replaced and examination time can be substantially decreased. The 3DT2 and 2DT2 sequences provided similar reproducibility for diagnosis of deep infiltrating endometriosis, but diagnostic confidence scores were higher using a combination of the sequences, compared to solely 2DT2-weighted MR imaging. This may be explained by the slice thickness and interslice gap used in 2DT2-weighted MR imaging, as small lesions may be depicted on only one slice of an MR imaging plane, and may therefore be more difficult to assess. Significantly more artefacts were present, using 3DT2, and the overall image quality was significantly higher using 2DT2. We conclude, 3DT2-weighted MR imaging may be valuable in smaller DIE lesions, but 3DT2 may not completely replace 2DT2, due to the lower image quality.