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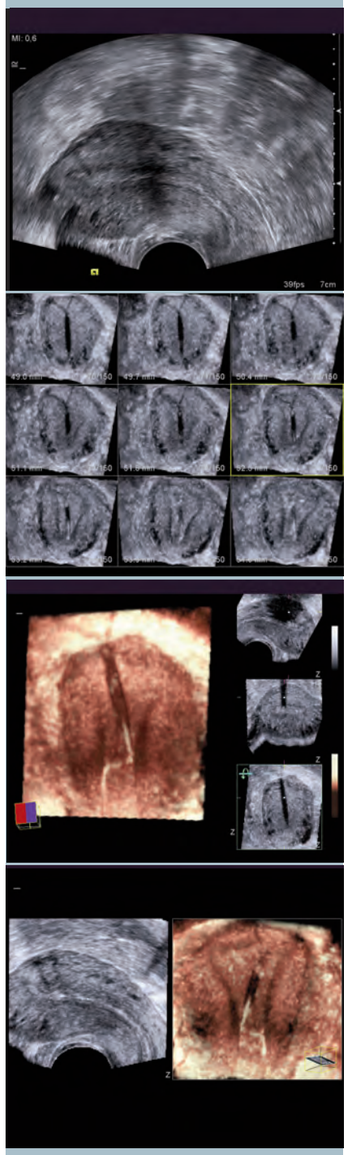

WHITEPAPER

Volume Sonography using Amnioscopic Rendering in determination of partial uterine perforation with a intrauterine device

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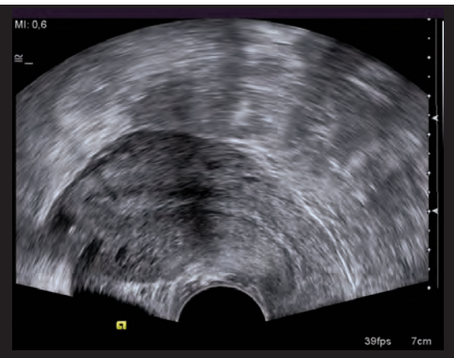

Figure 1) Longitudinal view of uterus:
Only a part of the stem is visible in standard 2D Imaging.

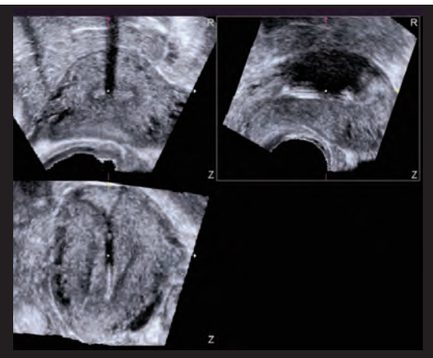

Figure 2) Three orthogonal views: The LNG-IUD as a whole is visualised in the uterus.

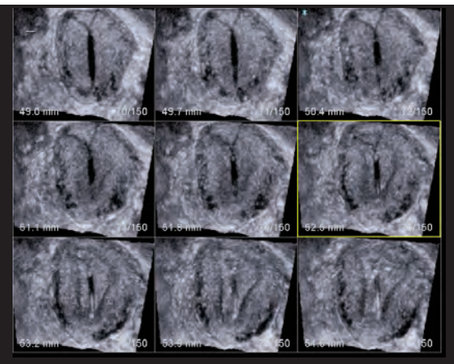

Figure 3) The exact position of the LNG-IUD in different levels of the uterus can be defined in MultiSlice.

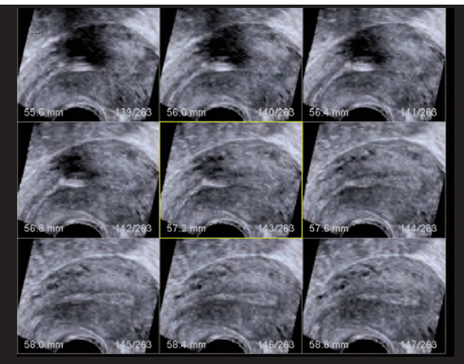

Figure 3a) MultiSlice Vertical Lines.

Volume Sonography using Amnioscopic Rendering in determination of partial uterine perforation with a intrauterine device

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Abstract

Objective
To report the improper insertion of intrauterine device in a post-partum patient.

Methods
Three-dimensional (3D) sonographic examination is used to determine the location of a intrauterine device. Sonographic volume application - Amnioscopic Rendering provides a more exact spatial relationship among the structures in utero and identifies the pathological changes due to partial perforation.

Results
Three-dimensional (3D) ultrasonography with the special volume application - Amnioscopic Rendering provides a more exact spatial relationship among the structures in utero and shows pathological findings due to improper insertion of the intrauterine device- transudate in the uterine cavum and local oedema of the myometrium, suggesting the partial perforation. Amnioscopic Rendering enables exact view into the structures, which are of different depth levels or differ in echogenicity. The application more clearly differentiates the borders, improving visualization of the pathological changes in utero.

Conclusion
The diagnosis of a correct position of the intrauterine device is superior using 3D versus 2D ultrasound examination. 3D Amnioscopic Rendering ultrasonography may prove to be of additional value in cases of suspected partial perforation, for visualization of pathological changes in utero.

Introduction
The levonorgestrel intrauterine device (LNG-IUD) (Mirena; Bayer Schering Pharma AG, Berlin, Germany) represents one of the modern intrauterine contraceptive devices available on the market. The device is proven to be a highly effective mode of contraception[1,2] and because it induces hypomenorrhea or amenorrhea, it is also used to treat menorrhagia, dysmenorrhea and adenomyosis [3,4,5]. It is the device of a choice compared to Copper intrauterine device, which is seldom used due to several side effects, including menorrhagia.

The LNG-IUD is a T-shaped device with a polyethylene frame containing barium sulfate. On the 32 mm vertical stem, there is a reservoir, containing a mixture of LNG and silicone covered by a silicone membrane. Both arms of the horizontal portion measure 32 mm.

Ultrasound examination is recommended before and after intrauterine device insertion. Before insertion, a retroflexed uterus, uterus myomatosus, abnormal uterine development such as Mullerian duct anomalies, adenomyosis or partial Aschermann syndrome can be identified. Although the position may be checked immediately after insertion, it is advised to recheck 2-3 months later for its correct position by ultrasonography.
A patient with partial perforation of myometrium due to intrauterine device insertion, detected by three-dimensional (3D) ultrasonography is presented.

A written informed consent was obtained from the woman to report this case.

Case report
A 32-year-old woman, gravida 2, para 2, was referred for examination due to serious pains, which started within hours after the insertion of the levonorgestrel intrauterine device. The pain was serious enough that she asked for the removal the LNG-IUD. The IUD was inserted the same day at the time of her regular check 6 weeks after vaginal delivery of her second uncomplicated pregnancy. She was otherwise healthy, reported no chronic or acute diseases, took no drugs, she was breastfeeding. Gynecological medical history revealed no uterine abnormalities, myomas or gynecological operations, she reported no abnormal bleeding or ultrasound to check the position of the IUD immediately after insertion. On physical examination a palpable enlarged, painful uterus was noted. Visible wires through the cervical os and weak bleeding were seen upon examination.

Methods
Sonographic examination (ACUSON S2000, Siemens Medical Solutions, Mountain View, CA, USA) using a vaginal probe was used to determine the intrauterine location of a LNG-IUD (**Figure 1**). Using two-dimensional (2D) ultrasound imaging, we were unable to determine the possible partial perforation we suspected (**Figure 2**).
Three-dimensional (3D) ultrasonography was performed for determination of the IUD position (**Figure 3**). From the sagittal view, a volume was acquired with the acquisition angle of 120 ○ . To obtain good visualization of the position of the stem, as well as of both the arms, the ROI of the acquired 3D volume was placed just under the level of the uterine cavity in order to render the device's shadow. The so called "shadow image" of the IUD[6] was further enhanced using Amnioscopic Rendering, a Siemens exclusive technology. Amnioscopic Rendering on the ACUSON S2000 Ultrasound System provides improved resolution of the rendered volume through use of a user-movable light source. Spatial relationships among the structures were clearly differentiated with this rendering tool (**Figure 4**). The uterine cavity was seen very clearly and we could identify a small amount of transudate, which was present due to partial perforation of myometrium at one of the lateral sides (**Figure 5**). Local oedema of the myometrium was seen as well, supporting the diagnosis of partial perforation, and the cause of the patient's pain, discomfort and weak bleeding. In this case, Amnioscopic Rendering enabled visualization of structures, which are at different depths or different echogenicities. The application provided better differentiation of the borders and identification of oedema in the tissues and free fluid in the uterine cavity., (**Figure 4,5**).
Although we proposed to wait the patient asked for the removal of the LNG-IUD. It was removed immediately after the ultrasound examination.

Discussion
We presented partial perforation of myometrium due to intrauterine device insertion, detected by 3D ultrasonography.

Complications during the insertion or malposition of a intrauterine device may be caused by several factors including: limited insertion experience, insertion within the first 6 months after delivery, nulliparity, history of recurrent miscarriage, retroflexed uterus, undiagnosed malformations of the uterus and scars after uterine operations[7]. There are reliable symptoms suggesting partial or complete perforation of the uterus with a LNG-IUD; most patients report starting soon after the insertion. Some have weak bleeding as well as discomfort. Following partial uterine perforation, the IUD might migrate due to uterine contraction to the proper position[8,9,10] at which time the pain should be alleviated. If partial perforation with the LNG-IUD is not visible on two-dimensional (2D) ultrasound imaging then three-dimensional (3D) ultrasonography should be performed for exact determination of the position [11,12] . Amnioscopic Rendering is a method of choice for better evaluation of the IUD position as well as pathological processes, such as damage of the uterus, producing the oedema of the myometrium and transudation in the cavity. The risk for adhesions or complications in case of non-removal the IUD in situ are unknown, but probably low when compared to the copper IUDs. Complications such as infection or bladder perforation should be rare or occur only when total perforation is produced.

Ultrasound examination is recommended before and after LNG-IUD insertion. Before insertion, we can identify a retroflexed uterus, uterus myomatosus, abnormal uterine development such as Mullerian duct anomalies, adenomyosis, or partial Aschermann syndrome. When a IUD must be inserted under general anesthesia due to cervical stiffness, placement under ultrasound guidance is recommended in order to avoid perforation or malposition.
Although the position may be checked immediately after insertion, it is advised to recheck 2-3 months later for its correct position. The IUD may migrate spontaneously and an initially correctly placed IUD may be expulsed some weeks after insertion. Amenorrhea itself does not provide proof of correct location of the device, nor does the presence of visible wires through the cervical os. In some rare case the LNG-IUD might be expulsed or perforates the uterine wall. The risk for uterine perforation is between 1 and 2.6 per 10007. A low-lying or endocervical IUD is probably more prone to spontaneous expulsion and therefore insufficient contraceptive efficacy, whereas a high transverse lie probably has no effect on high contraceptive efficacy.

In summary
3D ultrasound provides superior visualization of LNG-IUD position over conventional 2D ultrasound examination. Amnioscopic Rendering ultrasonography may prove to be of additional value especially in cases of suspected partial perforation and the subtle signs, demonstrated in uterine cavum, myometrium and surrounding structures due to extravasation and local oedema of the uterine wall. We believe the cases of malposition of a LNG-IUD should be diagnosed in order to prevent the serious side effects of partial or complete perforation and its complications. The need of repeating the sonographic examination and confirmation of the correct position of LNG-IUD 2-3 months after insertion would be recommended.

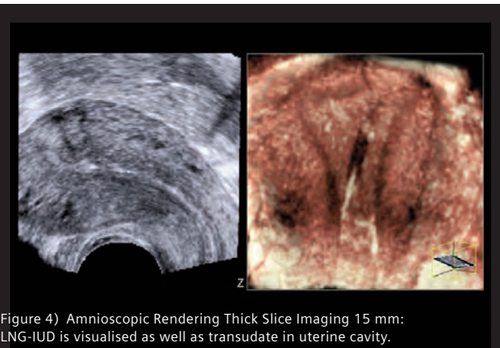

Figure 4) Amnioscopic Rendering Thick Slice Imaging 15 mm:
LNG-IUD is visualised as well as transudate in uterine cavity.
Render view direction posterior to anterior.

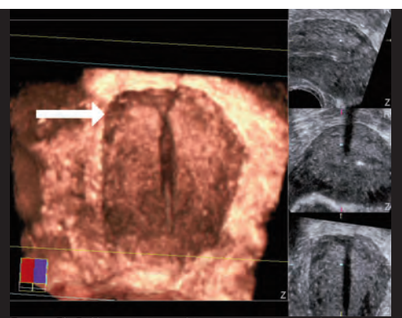

Figure 5) Differentiation of the local oedema of the myometrium in the uterine fundus and transudate in uterine cavum, demonstrating pathological changes of uterus due to improper insertion of LNG-IUD.

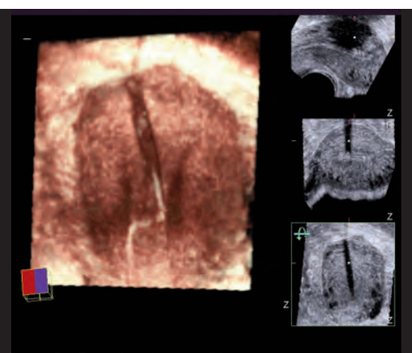

Figure 5a) Thick Slice Imaging 20mm.

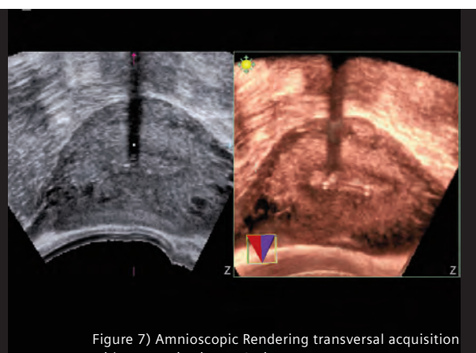

Figure 7) Amnioscopic Rendering transversal acquisition with syncronization to A-view.