ROLE OF THREE-DIMENSIONAL ULTRASOUND IN DIAGNOSIS OF UTERINE CAUSES OF INFERTILITY

Thesis

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ABSTRACT

Assessment of the uterine morphology and exclusion of the endometrial pathology are essential before commencement of medically assisted reproduction. It is clear that anatomic uterine abnormalities, including submucous leiomyomas, intrauterine adhesions and congenital uterine anomalies interfere with implantation of the developing embryo and may cause recurrent pregnancy loss. Since 3D ultrasound provides images of the uterine cavity in multiple tomographic sections, intracavitary structures become clearly visible.

In this work will evaluate the role of 3D ultrasound in diagnosis of uterine causes of infertility. Also will evaluate the benefit of using 3D ultrasound over 2D ultrasound and other imaging techniques in assessment of the uterine causes of infertility.

Key words: 3D ultrasound – Infertility – Uterus.

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LIST OF ABBREVIATIONS

2D: Two Dimensional

3D: Three Dimensional

CT: Computerized Tomography

DES: Diethylstilbestrol

HSG: Hysterosalpingography

MRI: Magnetic resonance imaging

SIS: Saline infusion sonography

U/S: Ultrasound

INTRODUCTION

Assessment of the uterine morphology and exclusion of the endometrial pathology are essential before commencement of medically assisted reproduction. It is clear that anatomic uterine abnormalities, including submucous leiomyomas, intrauterine adhesions and congenital uterine anomalies interfere with implantation of the developing embryo and may cause recurrent pregnancy loss. Since 3D ultrasound provides images of the uterine cavity in multiple tomographic sections, intracavitary structures become clearly visible.

3D Ultrasound is very useful for demonstration of the intracavitary pathologies, such as uterine anomalies, adhesions, submucous leiomyomas and endometrial polyps. Simultaneous display of the three perpendicular planes especially the coronal plane offers a more comprehensive overview of the examined area and gives access to planes unobtainable by conventional 2D ultrasonographic examination. Surface rendering may confirm the presence of pathological findings in equivocal cases, and characterize their appearance, size, volume and relationship to the surrounding structures.

AIM OF WORK

The aim of this work is to evaluate the role of 3D ultrasound in diagnosis of uterine causes of infertility. Also to evaluate the benefit of using 3D ultrasound over 2D ultrasound and other imaging techniques in assessment of the uterine causes of infertility.

UTERINE CAUSES OF INFERTILITY

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The most commonly accepted definition of the term of primary infertility is the lack of pregnancy (regardless of cause) after 1 year of unprotected intercourse. Infertility affects approximately 15% of couples of reproductive age. Its prevalence has been stable during the past 50 years, although a shift in etiology and in the age of the patient population has occurred. (Garcia et al., 2006)

The uterine cavity must provide an environment for successful sperm immigration from the cervix to the fallopian tube. The normality of the mucosal lining, glandular secretion and vascularity are necessary to support implantation and placentation. Anatomical uterine anomalies as well as uterine pathology can lead to poor reproductive performance. (Kurjak et al., 2005)

The uterus is the final destination for the embryo and the place where the fetus develops until delivery. Therefore, uterine factors may be associated with primary or secondary infertility or with pregnancy wastage and premature delivery. Uterine factors can be congenital or acquired. They may affect the endometrium or the myometrium and are responsible for 2-5% of infertility cases. Other problems affect the development and function of the endometrium. (Garcia et al., 2006)

Problems of the uterus and uterine lining that can cause or contribute to reproductive problems such as infertility:

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- 1. Congenital uterine malformations.
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- 2. Uterine Polyps.
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- 3. Uterine Fibroids.
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- 4. Intrauterine adhesions (scar tissue within the uterine cavity, also called Asherman's Syndrome. This can interfere with conception, or can increase the risk of a miscarriage).
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- 5. Luteal phase defect (an uncommon condition that involves inadequate development of the microscopic and cellular changes in the endometrial lining of the uterus after ovulation and exposure to the hormone progesterone).
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- 6. Thin endometrial lining (this is also uncommon. We like to see a lining of at least 8mm in thickness when measured by ultrasound at the time of maximal thickness during the cycle. In general, 8-13 mm is good, less than 6 is potentially a problem, and greater than 15 or so could possibly reduce chances for a successful pregnancy). (**Gurnee et al.**, 2007)

CONGENITAL UTERINE ANOMALIES

Müllerian duct anomalies are estimated to occur in 0.1-0.5% of women. The true prevalence is unknown because the anomalies usually are discovered in patients presenting with infertility. Full-term pregnancies have occurred in patients with forms of bicornuate, septate, or didelphys uteri; therefore, true prevalence may be slightly higher than currently estimated. Simon et al found that in the healthy fertile population, müllerian duct anomalies have a prevalence of 3.2%. (Simon et al., 1991)

Müllerian duct anomalies are an uncommon but often treatable causes of infertility. Patients with müllerian duct anomalies are known to have a higher incidence of infertility. The role of imaging is to help detect, diagnose, and distinguish surgically correctable forms of müllerian duct anomalies from inoperable forms. In some correctable lesions, the surgical approach is altered based on imaging findings. (Troiano, 2004)

EMBRYOLOGY

Two paired müllerian ducts ultimately develop into the structures of the female reproductive tract. The structures include the fallopian tubes, uterus, cervix, and upper two thirds of the vagina. The ovaries and lower one third of the vagina have separate embryologic origins not derived from the müllerian system.

Complete formation and differentiation of the müllerian ducts into the segments of the female reproductive tract depend on completion of 3 phases of development as follows:

- Organogenesis: One or both müllerian ducts may not develop fully, resulting in abnormalities such as uterine agenesis or hypoplasia (bilateral) or unicornuate uterus (unilateral).
- Fusion: The process during which the lower segments of the paired müllerian ducts fuse to form the uterus, cervix, and upper vagina is termed lateral fusion. Failure of fusion results in anomalies such as bicornuate or didelphys uterus. The term vertical fusion

occasionally is used to refer to fusion of the ascending sinovaginal bulb with the descending müllerian system (ie, fusion of the lower one third and upper two thirds of the vagina). Complete vertical fusion forms a normal patent vagina, while incomplete vertical fusion results in an imperforate hymen.

- Septal resorption: After the lower müllerian ducts fuse, a central septum is present, which subsequently must be resorbed to form a single uterine cavity and cervix. Failure of resorption is the cause of septate uterus.

The ovaries and the lower vagina are not derived from the müllerian system. The ovaries are derived from germ cells that migrate from the primitive yolk sac into the mesenchyme of the peritoneal cavity and subsequently develop into ova and supporting cells. The lower vagina arises from the sinovaginal bulb, which fuses with the müllerian-derived upper two thirds to form the complete vagina. (Kaufman et al., 2008)

ETIOLOGY

Uterine malformations are secondary to failure in development, reabsorption or fusion of Müllerian ducts. Around the sixth week of the embryogenesis, an invagination of the coelomic lining epithelium forms a depression creating a sulcus, whose borders fuse to form the lateral Müllerian ducts (or paramesonephric ducts). The Müllerian ducts initially are formed in the upper dorsal wall of the coelomic cavity and progress caudally to enter the pelvis where they incline towards the center, fusing medially. Farther on, the caudal progress results in a contact of these