

## Virtual Sonographic Embryoscopy: A New Tool for Evaluation of Early Pregnancy

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### Abstract

Observation of the gestational sac by vaginal sonography is a key-element of early pregnancy evaluation. Here we present a new imaging technique, enabling 3-dimensional virtual reconstruction of the early embryonic structures within gestational sacs with the use of computerized analysis of 2-dimensional sonographic recordings. This technique, named virtual sonographic embryoscopy, offers a higher precision and spatial resolution as compared to conventional ultrasound and appears to be useful to predict the risk of early pregnancy loss.

**Keywords:** *Virtual Embryoscopy; Sonographic Embryoscopy; Ultrasound Embryoscopy; Gestational Sac; Early Pregnancy Evaluation; Fly Thru Ultrasound Technology*

### Introduction

The observation of a gestational sac in the uterine cavity by vaginal ultrasound enables the first direct demonstration of an intrauterine pregnancy and may reveal a risk of early pregnancy loss. The size and morphology of the early embryonic structures, the embryo body, the yolk sac, and the vitelline duct through which they communicate, are of predictive value as to pregnancy outcome and the risk of abnormal embryonic development [1]. The examination of the gestational sac and its contents is usually carried out by means of 2-dimensional and 3-dimensional ultrasound scanning.

Recently, the evolution of the so-called Fly Thru ultrasound technology, developed by Toshiba, made it possible to recreate 3-dimensional virtual images of body cavities and canals visualized from their interior, as if the eye of the observer were present inside. These "virtual endoscopy" techniques have been found useful for some gynaecological examinations. Virtual sonographic hysteroscopy made it possible to detect a uterine synechia which was subsequently confirmed and removed by conventional operative hysteroscopy [2]. The same technique was later adapted for the examination of the fallopian tubes, as virtual sonographic hysterosalpingoscopy, and made it possible to directly visualize an ectopically implanted gestational sac [3]. Here we show how this ultrasound-based virtual imaging technique can be applied to the study of early gestational sacs implanted in the uterus.

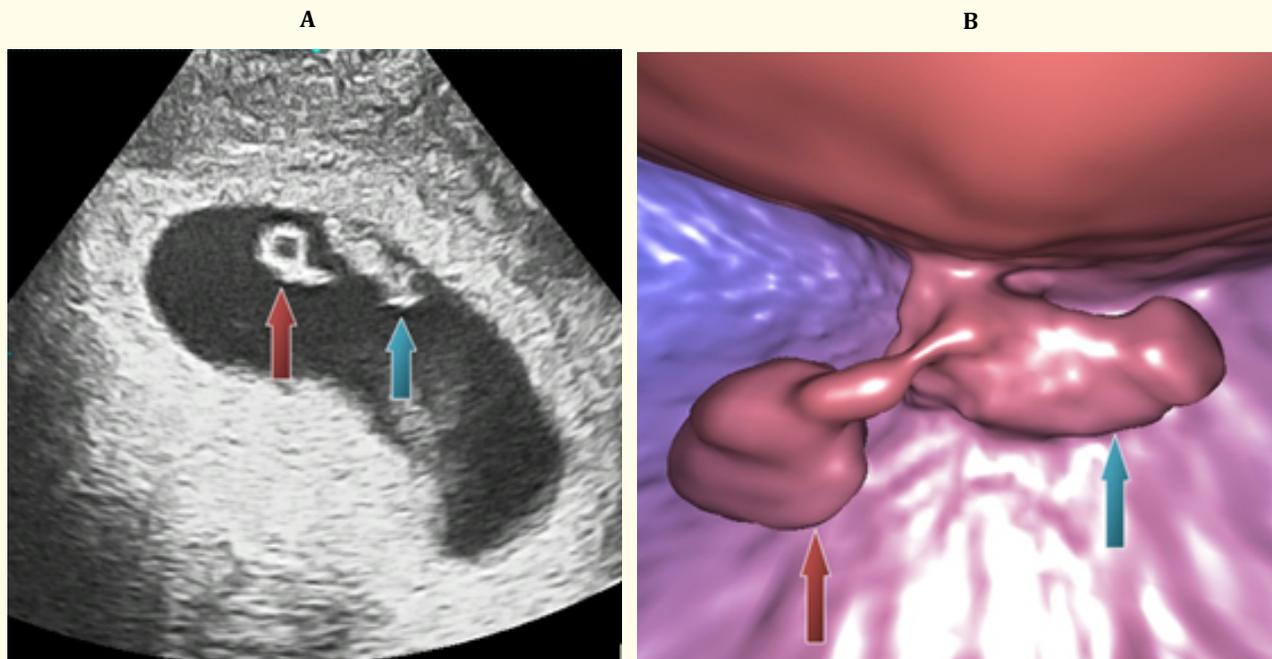
### Materials and Methods

This study involves 48 women undergoing the first sonographic examination to confirm intrauterine pregnancy after a previous assisted reproduction attempt. The technique of virtual sonographic embryoscopy consists of two sequential phases: first, image acquisition, and second, image processing. During the phase of image acquisition, a short sequence of two-dimensional images of the gestational sac is recorded from the vagina with the use of 11CV3 transvaginal sonographic probe (Toshiba Medical Systems Europe, Zoetermeer, The

Netherlands). During the phase of image processing, the planar two-dimensional recordings are converted into three-dimensional (pictures) and 4-dimensional (videos) virtual reconstructions of the gestational sac cavity, with the use of the Fly Thru technology (Toshiba) incorporated in the ultrasound machine (Aplio 500 Platinum). During this phase, the operator can “fly” freely through the cavity in search for the most informative views of the embryonic structures.

### Results and Discussion

Three-dimensional images created by virtual sonographic embryoscopy were analyzed together with conventional 2-dimensional ultrasound images. As compared to the planar 2-dimensional images (Figure 1A), the virtual 3-dimensional images (Figure 1B) provided a better perception of the size and spatial configuration of the embryo, the yolk sac and the vitelline duct within the gestational sacs examined. This impression was further enhanced by the possibility to observe virtual images of these structures from different angles and perspectives. Together, these features of virtual sonographic embryoscopy facilitated the evaluation of embryo development with respect to the gestational age. Further study is needed to compare the accuracy and liability of the observations made by virtual sonographic embryoscopy with those of conventional 3-dimensional transvaginal sonography.



**Figure 1:** A 2-dimensional sonographic image of a human embryo 4 weeks after fertilization (A) and the same embryo visualized by virtual embryoscopy (B). The embryonic body (blue arrow) and the yolk sac (red arrow) are connected by the vitelline duct.

### Conclusion

Virtual sonographic embryoscopy is a new imaging technique for 3-dimensional visualization of gestational sacs. The precision and spatial resolution of the images created by this technique appears to be useful to predict the risk of early pregnancy loss.

### Conflict of Interest

There is no conflict of interest in relation with this study.

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