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White paper

The Value of 4D HyCoSy in the Assessment of Tubal Patency

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Introduction

Fallopian tubal factors are responsible for up to 30–35% of female infertility [1]. Therefore, accurate evaluation of the fallopian tube is an important step in the diagnostic work-up of infertile women. Hysterosalpingo-contrast sonography (HyCoSy) is a technique that allows the sonographic assessment of tubal patency and examination of the uterine cavity. HyCoSy can provide comprehensive information of the uterus and fallopian tubes with prominent advantages of cost-effectivity, expeditiousness, non-radiation and reliable results. Four-dimensional HyCoSy (4D HyCoSy) acquisition of the entire fallopian tube allows easy visualization of the contrast medium flow throughout the entire tubal length. The purpose of this report is to evaluate the accuracy of 4D HyCoSy in assessing fallopian tubal patency.

Materials and Methods

The study was approved by the ethics committee of The First Affiliated Hospital of Shantou University Medical College, China. We completed 4D HyCoSy procedures for infertility in all patients, who were clinically documented as being infertile.

Inclusion criteria included: 1) no vaginal bleeding and 2) no acute or subacute inflammation of the reproductive system. The 4D HyCoSy procedure and potential adverse effects were explained, and written consent was obtained from all patients.

A HERA W10 ultrasound machine (SAMSUNG MEDISON, CO. LTD., Korea) with APM (Asymmetric Pulse Modulation) technology was used. APM is an advanced transmitting and receiving technology for contrast imaging and uses modulated transmitting signals in terms of both amplitude and phase. This technology helps to maximize the degree of oscillation of SonoVue® (ultrasound contrast agent, Bracco Imaging, Italy), thereby generating strong signals from contrast agents while minimizing signals from normal tissues. This technology provides high contrast resolution and uniformity at all depths of penetration.

The mechanical index of the instrument was set at 0.14, scan quality set at medium and the direction set from front to back. A 3.0–10.0 MHz transvaginal volume probe (EV3-10B) and a volume scanning angle of 120° for maximal coverage of the bilateral uterine horns and ovaries was used in the examinations. SonoVue® was used as the ultrasonic contrast agent The dry powder contrast agent was diluted to 5.0ml with 0.9% chlorine sodium solution. After sufficient shaking, 2.5 mL of the microbubble suspension was extracted and dissolved in 17.5 mL of 0.9% sodium chloride solution.

The 4D HyCoSy procedure was performed by an experienced sonographer between the 3rd and 10th days after menstrual bleeding had stopped. Prior to the examination, a transvaginal ultrasound exam was performed to assess the pelvic anatomy, noting the position of the ovaries and presence of any hydrosalpinxes. We also routinely performed a 3D volume scan of the uterus to check for the presence of any congenital uterine malformations. The perineum and vagina were disinfected with iodophor solution. The cervix was visualized with a speculum, and the catheter was introduced into the cervical os under aseptic conditions, using a tenaculum when needed. A Foley catheter was introduced into the uterine cavity. We then injected 2 mL of normal saline into the balloon of the Foley catheter, to fix it in place, removed the speculum, taking care not to dislodge the catheter, and the ultrasound transducer was introduced into the vagina again.

The process of 4D HyCoSy was carried out as follows [2]. The transvaginal volume probe was positioned in such a way as to visualize the transverse section of the uterus. When the APM mode was switched on, the view of the pelvic cavity became completely anechoic. The 4D volume box was placed over this region and the region of 4D volume acquisition was made as wide as possible, so that the uterus, both ovaries and the whole length of the fallopian tube were visualized. The volume 4D scan was set at 120°. A 20-mL syringe fully loaded with diluted contrast medium was attached to the external end of the catheter. When the ultrasound contrast agent was seen flowing into both uterine horns, volume-data acquisition was switched on. Dedicated software allowed the volume data of the contrast medium in the uterus and fallopian tubes to be obtained automatically for subsequent analysis. The acquisition time of volume data was approximately 20s.

Results and Discussion

Sonographic features of patent or occluded tubes on 4D HyCoSy

On 4D HyCoSy of patent fallopian tubes, the entire length of the tubes was seen in somethe following cases. Spill of free microbubbles from the fimbria end of the tubes was visualized (Figure 1-6). We visualized spill of free microbubbles around the ipsilateral ovary of the right side while there was no visualization on the left tubes. We saw neither fimbriaspill from the left tubes, nor spill of free microbubbles around the leftovaries (Figure 7-9). Both of Proximal fallopian tubes were occluded, and we could not see the tubes (Figure 10).

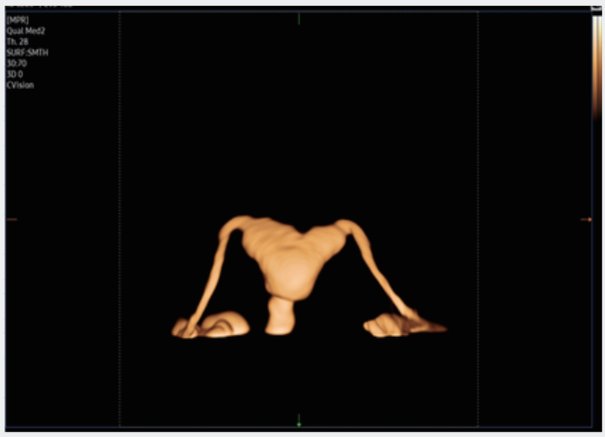
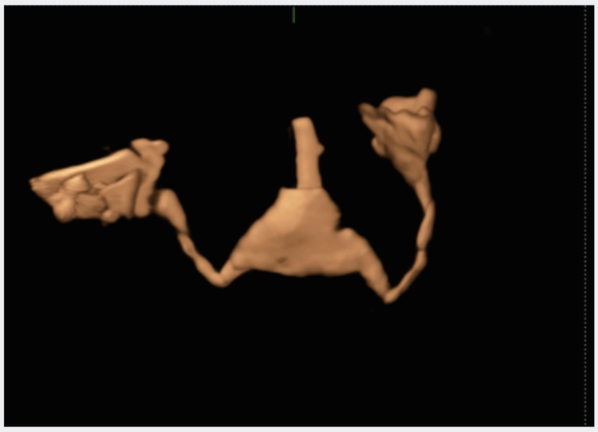


Figure 1

Figure 2



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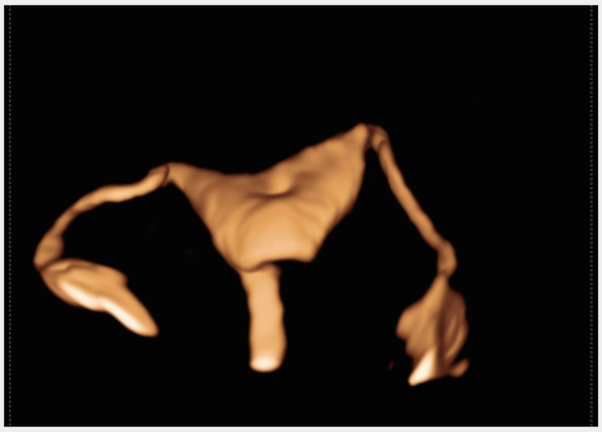

Figure 4

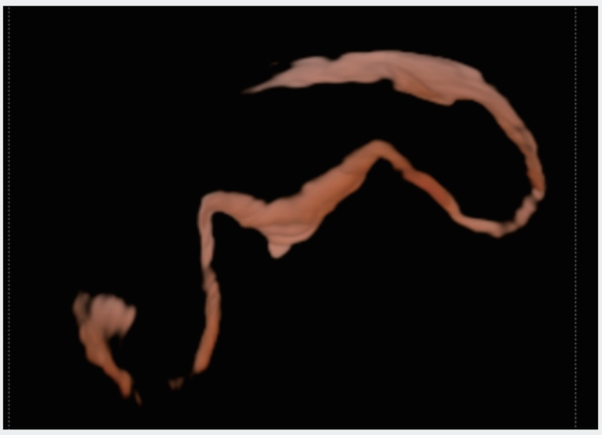

Figure 5

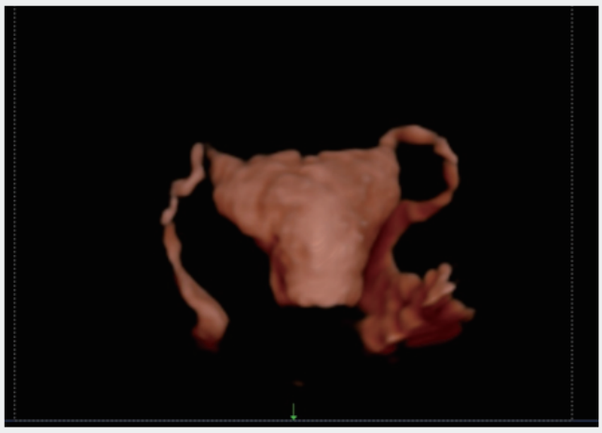

Figure 6

Figure 1-6. 4D HyCoSy showing bilateral fallopian tubal patency. The entire fallopian tube develops completely. There is ejection-like overflow of the contrast medium from the fallopian tube fimbria.

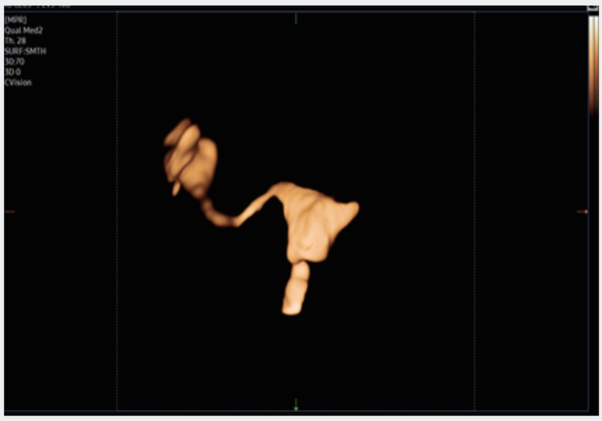

Figure 7

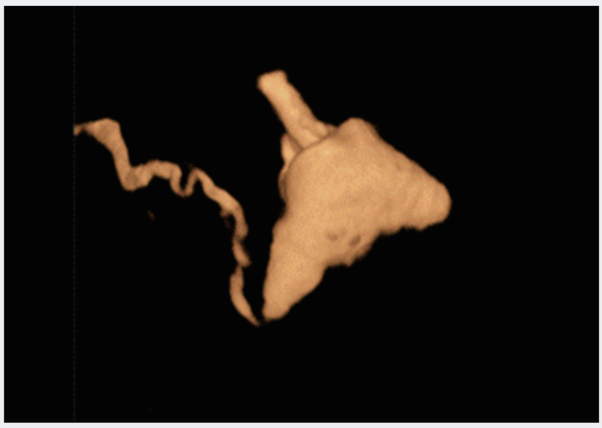

Figure 8

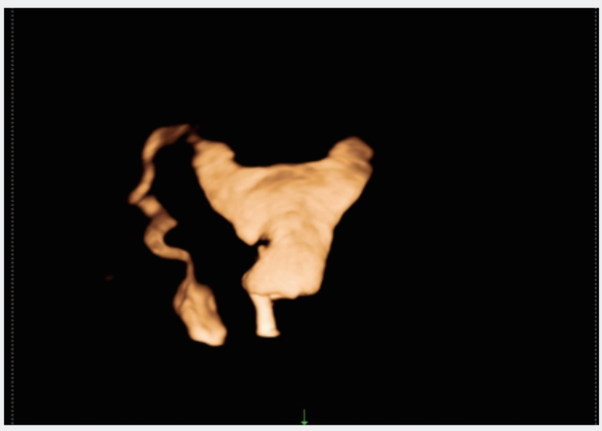

Figure 9

Figure 7-9. 4D HyCoSy showing left fallopian tubal obstruction, and right fallopian tubal patency. Only patents right fallopian tubes were visible. The left fallopian tubes were not visible

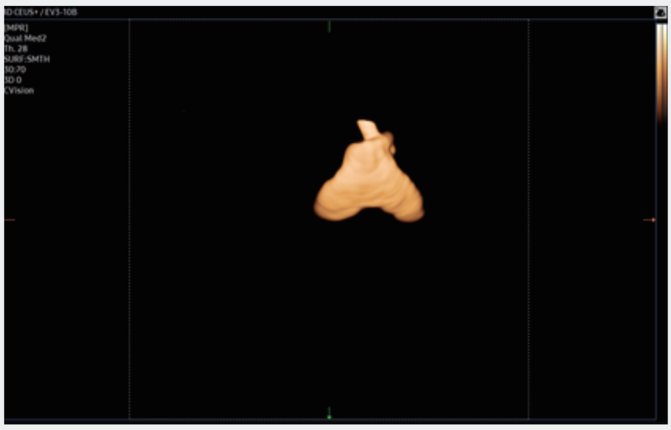

Figure 10. Complete bilateral obstruction of the proximal fallopian tubes

Traditionally, the techniques used to evaluate tubal patency include hydrotubation, X-ray hysterosalpingography (HSG), laparoscopy and the dye test. However, these techniques have their disadvantages. Hydrotubation is rarely used now because it is used blindly and has poor accuracy. Ontheotherhand, HSG shows high accuracy (83%) in the diagnosis of tubal patency. However, HSG produces radiation and is associated with potentially allergenic agents. Laparoscopy and the dye test are widely regarded as the current gold standard because of their intuitive approach and high accuracy. However, these techniques are expensive, invasive, and associated with anesthetic and surgical risks.

2D HyCoSy is frequently performed as part of the initial investigation in patients suffering from infertility. However, 2D HyCoSy also has its limitations, the entiref fallopian tube cannot be visualized in most scanning planes due to the tortuosity of the tubes.

Automated 4D volume acquisition of the entire fallopian tubes allow easy visualization of the contrast medium flow throughout the tubal length. HERA W10 ultrasound machine with APM technology, enables differentiation of contrast medium in the tubes and around the ovaries from adjacent tissues and organs. It optimizes the use of ultrasound contrast medium and enhances visualization of the fallopian tubes by allowing the operator to distinguish between the harmonic response of the contrast medium microbubbles and the broadband ultrasonic signals from pelvic organs.

4D HyCoSy can provide more information in assessing fallopian tubal patency. First of all, the dynamic image of 4D HyCoSy allows the operator to observe the entire course of the contrast medium developing in tubes rather than just an instant capture: the video is close to the real anatomy and physiology of the tubes. Secondly, the dynamic video can be saved for post analysis, can be replayed by seconds for discriminating the real tubes in details, and the observation is multi-plane, multi-angle and multi-period. Thirdly, bilateral tubes need not be traced respectively as in 2D and the injection is required only once especially when bilateral tubes are patenty[3].

Conclusion

4D HyCoSy may be considered clinically valuable as a practical, non-invasive, primary investigatory tool for evaluating tubal patency. 4D HyCoSy in the HERA W10 ultrasound machine with APM technology can enhance visualization of the fallopian tubes and provide more information in assessing fallopian tubal patency in infertility diagnosis.

References

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