

# Diagnosing hydrosalpinx by three-dimensional ultrasonography in inversion mode

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## ABSTRACT

**Introduction:** Tubal abnormalities like hydrosalpinx, a suggestive feature of a tubal disease need to be screened in infertile women before the treatment. Although magnetic resonance imaging scan offers many advantages over other diagnostic algorithms, the procedure is relatively expensive and not readily accessible compared with the other forms of imaging. **Case Series:** In this case series, we demonstrated the advantages of three-dimensional transvaginal ultrasonography in diagnosis of different features of hydrosalpinx with superior quality imaging. Five infertile women those were suspected for pelvic inflammation upon clinical examination were screened for hydrosalpinx by three-dimensional transvaginal ultrasonography (TV-USG). Different features of hydrosalpinx such as dilated fallopian tubes along with a paraovarian cyst, typical retort shaped cystic

lesion, S-shaped cystic lesion, multiloculated nature of the fallopian tube were visualized. **Conclusion:** The findings obtained by 3D TV-USG almost comparable to MRI scan. Therefore, we feel that the incorporation of 3D modality in the imaging procedures improves the evaluation of complex pelvic masses.

**Keywords:** Fallopian tubes, Infertility, Inversion mode, Pelvic inflammation, Three-dimensional imaging

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## INTRODUCTION

Pelvic inflammatory disease (PID) manifests in multiple ways such as pyosalpinx, hematosalpinx, tubo-ovarian complex and tubo-ovarian abscess and hydrosalpinx [1]. Hydrosalpinx results from obstruction of the fallopian tube following pelvic inflammatory disease, surgery or endometriosis. The diagnosis of hydrosalpinx in an infertile patient is very important in planning the treatment. Ultrasonography (USG), computed tomography (CT) scan and magnetic resonance imaging (MRI) scan are non-invasive modalities in diagnosing hydrosalpinx. Among transabdominal (TB) ultrasonography and transvaginal (TV) ultrasonography,

TV is superior in diagnosing pelvic pathologies because of the use of higher frequency probes [2].

Distinct ultrasonography markers have been described in literature by various workers [1, 3, 4]. These markers include tubular shape of the cystic mass, echogenic wall structure, incomplete septation, waist sign, etc. Short echogenic projections into the lumen referred to as beads on a string appearance on cross sectional planes and thick interlaying echos described as cog-wheel appearance have also been mentioned. Studies have suggested that cog-wheel appearance and beads on a string appearance results from acute or chronic stages of pelvic inflammation respectively [5]. Separate visualization of the ipsilateral ovaries is important. The most common features of hydrosalpinx are tubular C or S shaped cystic mass and incomplete septation. In spite of all the markers that can be identified, the accurate diagnosis of hydrosalpinx may be difficult in certain cases particularly, to distinguish them from other cystic lesions in the pelvis such as complex ovarian cysts and other peritoneal inclusion cyst.

In this case series, we emphasized on the diagnosis of various features of hydrosalpinx in five infertile female patients using three-dimensional (3D) modality with superior quality images. The purpose of this presentation is to highlight the facts that with 3D imaging, not only the shape of the mass but also the wall structure and contents of the hydrosalpinx can be imaged. The images that result are like virtual macroscopic appearance of the fallopian tubes [6].

The patients were from Infertility Institute and Research Center, Secunderabad, Telangana, India, A center for reproductive medicine. The main complaint of the patients was inability to conceive. Two-dimensional transvaginal ultrasonography (Voluson™ E10, GE Healthcare, Austria. GmbH & Co OG) with endovaginal probe (GE-RIC5-9-D) was performed in all the patients as a part of the evaluation of infertility. The patients in whom hydrosalpinx was suspected, three-dimensional USG was done. The three-dimensional images were acquired in three orthogonal axes and then displayed on a rendered mode. The rendered images were then subjected to inverted mode that converts the anechoic voxels in the volume to echonic voxels. Three-dimensional images depicting the different features of hydrosalpinx are represented in Figures 1–5. These images also illustrate the easy delineation of the ipsilateral ovary with the technique of inversion mode.

## CASE SERIES

### Case 1

A 25-year-old woman presented with the history of pain in lower abdomen and infertility. 2D/3D transvaginal ultrasound of pelvis clearly revealed the dilated fallopian tubes along with a paraovarian cyst and a normal ovary as shown in Figure 1.

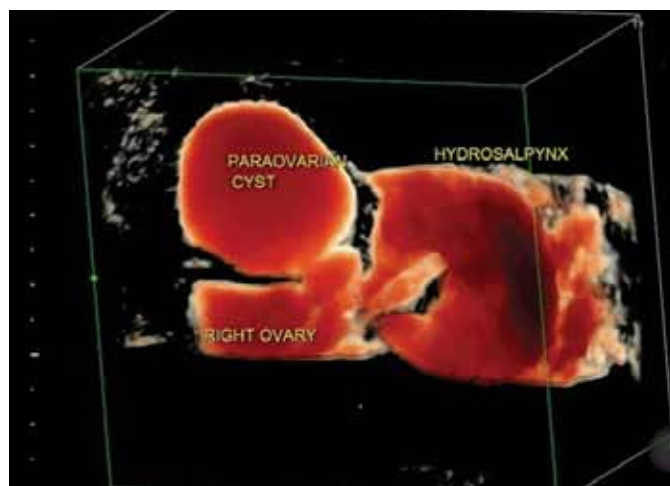


Figure 1: Image of C shaped hydrosalpinx and a paraovarian cyst in three-dimensional rendering mode.

### Case 2

A 30-year-old female presented with history of pain in lower abdomen and infertility. Upon clinical examination right adnexal mass was detected. Three-dimensional imaging of the lesion demonstrated tubular cystic lesion with waist sign which is a concentric indentation of opposite walls (Figure 2A). The rendered image of the same demonstrated the multiloculated nature of the fallopian tube (Figure 2B).

### Case 3

A 36-year-old female presented with history of infertility of four years duration. Two-dimensional/three-dimensional ultrasonography, a typical retort shaped cystic lesion with incomplete septation was observed conforming the diagnosis of hydrosalpinx (Figure 3A). Ipsilateral ovary with follicles was visualized clearly in this case, which enabled us to rule out the possibility of ovarian pathology (Figure 3B).

### Case 4

A 27-year-old female with five years of married life presented with infertility. She has a past history of left salpingectomy for ectopic pregnancy. Two-dimensional ultrasonography demonstrated S-shaped cystic lesion on the extended view (Figure 4A) which was not detected on clinical exam. Upon three-dimensional inversion mode the diagnosis of hydrosalpinx was made very clearly (Figure 4B).

### Case 5

A 38-year-old woman with previous history of pelvic inflammatory disease was presented for infertility. The two-dimensional ultrasonography revealed cystic



Figure 2: (A) Image of hydrosalpinx in three orthogonal planes showing waist sign and rendered structure in the right bottom box and (B) Enlarged representation of rendered image of hydrosalpinx.

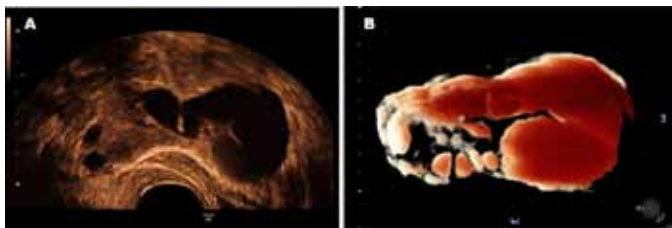


Figure 3: (A) Three-dimensional image of hydrosalpinx showing the typical retort shape in relation to the ipsilateral ovary and (B) Inversion mode displaying the hydrosalpinx and ovarian follicles.

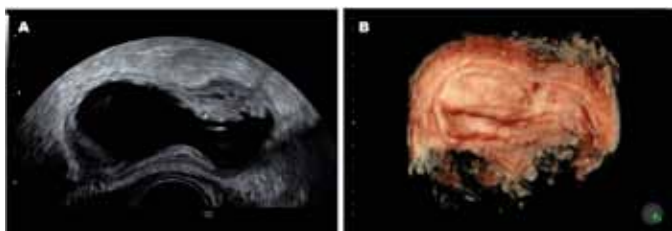


Figure 4: (A) S-shaped hydrosalpinx visualized on extended view and (B) Hydrosalpinx on inversion mode.

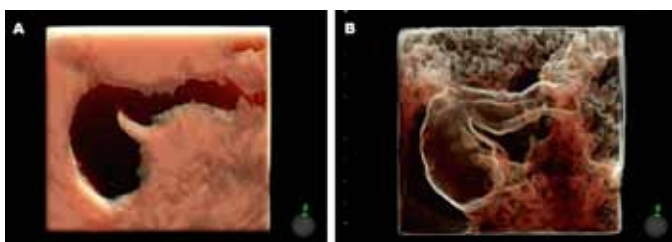


Figure 5: (A) Hydrosalpinx depicted in three-dimensional rendered mode and (B) Hydrosalpinx rendering in the silhouette mode.

adnexal lesions and subsequent rendered mode of three-dimensional imaging displayed the typical retort shape of the hydrosalpinx (Figure 5A). In the same patient, we applied new mode, single knob silhouette mode software. This mode is being used to assessing the uterine cavity. In this case, we used silhouette to screen the hydrosalpinx. As shown in Figure 5B, a clear outline of the hydrosalpinx with folded configuration is demonstrated.

## DISCUSSION

Pelvic inflammations such as hydrosalpinx lead to blockage of tubes, obstruct the way of egg which cause infertility. Even though in vitro fertilization (IVF) bypass the fallopian tubes by directly placing the embryo into the uterus, studies demonstrated that the pregnancy outcome in women with hydrosalpinx was lower [7]. Hence, Screening of such condition before planning the infertility treatment is mandatory. Diagnostic algorithms for evaluation of different features of hydrosalpinx are MRI scan, CT scan and ultrasonography. Though MRI scan is more accurate method for visualization of such conditions, the procedure is quite expensive, may not be readily available and not suitable for everyday practice. Three-dimensional imaging being less expensive and more readily accessible is preferable in such situations. However, MRI scan evaluation is necessary in doubtful cases to distinguish pelvic inflammations from complex ovarian masses. In this report, we emphasized on the three-dimensional ultrasonography superior image quality in elucidating nature of hydrosalpinx and in the differential diagnosis of adnexal masses. The three-dimensional pictures obtained by inversion mode have excellent capability of reproducing the shape and contents of the hydrosalpinx. Besides, any additional pathologies and delineation of ipsilateral ovaries is also possible. Fluid filled spaces can be easily displayed by applying the inversion mode. Pyosalpinx and hematosalpinx can also be visualized by adjusting the threshold settings to low level complex fluid collection in the cystic areas in the inversion cast. The findings obtained by three-dimensional transvaginal ultrasonography almost comparable to MRI scan. Therefore, we feel that the incorporation of three-dimensional modality in the imaging procedures improves the evaluation of complex pelvic masses. It offers first line imaging modality in screening of pelvis pathologies. Moreover, addition of color Doppler to ultrasonography enhances the diagnosis capability [8, 9]. The advantages of silhouette mode need to be screened in larger cohort to learn its usefulness in assessing the adnexal lesions.

## CONCLUSION

To conclude three-dimensional imaging extends the diagnostic capability of ultrasound especially in health care sectors where magnetic resonance imaging scan is not readily available or not affordable.

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### Author Contributions

Mamata Deenadayal – Substantial contributions to conception and design, Revising it critically for important intellectual content, Final approval of the version to be published

Kadambari – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Suhasini Donthi – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Aarthi Deenadayal Tolani – Substantial contributions to conception and design, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

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The corresponding author is the guarantor of submission.

### Source of Support

None

### Conflict of Interest

Authors declare no conflict of interest.

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