

# Sonography of the Pelvic Infection

Jose Bajo Arenas, Tirso Perez-Medina

## ABSTRACT

We describe sonographic findings of pelvis inflammatory disease. The diagnosis of initial acute PID (acute salpingitis) begins with a challenge for the doctor, due to the little sensibility of the clinic's criteria. The accumulation of pus inside the fallopian tube gives a location for the tubaric abscess or pyosalpinx, whose characteristic signal is the presence of purulent material in considerable quantities and is visible by means of a sonograph inside the tubal light. We refer a series of characteristic sings that advise us.

**Keywords:** Pelvic inflammatory disease (PID), Sonographic findings, Tubaric abscess, Pyosalpinx.

**How to cite this article:** Arenas JB, Perez-Medina T. Sonography of the Pelvic Infection. *Donald School J Ultrasound Obstet Gynecol* 2012;6(4):398-407.

**Source of support:** Nil

**Conflict of interest:** None declared

## INTRODUCTION

It is well-known how pelvic inflammatory disease (PID) applied to every inflammation or infection inside the pelvis, which by general rule, affects the genital organs and is hereditary. According to the Center for Disease Control and Prevention (CDC) in the United States, one condition concerning PID would be the absence of the relationship with pregnancy or surgery.<sup>1</sup>

Depending on the affected organs, the disease has received distinct names, which appear in Table 1, but in this day and age the most utilized term for the disease is PID. With the exception of numerous occasions, it is very difficult to individualize these cases and when the disease is initiated, it will affect progressively some of the organs or others.<sup>2</sup> The biggest protagonists are the fallopian tubes, which always find themselves involved.

The disease begins with an acute case of salpingitis (often silent), although if treated well results without relapses, but in a case that it is not treated or is done so inadequately the disease could evolve into a more serious form, toward the absence of any localizations (tubal of pyosalpinx, ovaric, tubo-ovarian, pelvic). If the process is stopped and cured in this stage, relapses are always discarded.<sup>3</sup>

From the first visit to the clinic, the most used classification is the Monif (Table 2), which is the one that we will refer to for the sonographic findings.

Laparoscopy has been, until this moment, the most precise diagnostic method to diagnose a case of salpingitis,

**Table 1: Terminology**

Affected organ	Name
Uterus	Endometritis, myometritis
Fallopian tube	Salpingitis, tubal abscess
Ovary	Ooforitis, ovaric abscess
Parametritis	Parametritis, pelvic-cellulitis
Peritoneum	Pelvipерitonitis
Vessel	Thrombophlebitis, lymphadenitis

**Table 2: Stages of pelvic inflammatory disease**

Stage I	Acute salpingitis
Stage II	Acute salpingitis with pelvipерitonitis
Stage III	Formation of abscesses: Tubal (pyosalpinx), ovaric, tubo-ovarian or pelvic abscess
Stage IV	Rupture of the abscess

classifying the findings according to the Table 2. But, its utilization is not always available or justified, especially in those cases with acute symptoms. In addition, the laparoscope does not detect cases of endometritis and cannot detect cases of acute salpingitis.

## Stage I: Acute Phase—Salpingitis

Normal uterian fallopian tubes are not visible in standard condition. It is assumed that the fallopian tubes are normal in the absence of adnexal out-of-ovary images, but not being able to visualize the fallopian tube does not mean that you can assume its permeability.

A normal fallopian tube can be seen by means of a transvaginal sonogram if free liquid exists in the bottom of the Douglas pouch (Fig. 1).<sup>4</sup> And so, a portion of the ampulla can be seen, including the fimbrias (Figs 2 and 3). If the liquid surrounds the fimbria, more extension of the tube can be seen (Fig. 4), but it is difficult to see all of its length.

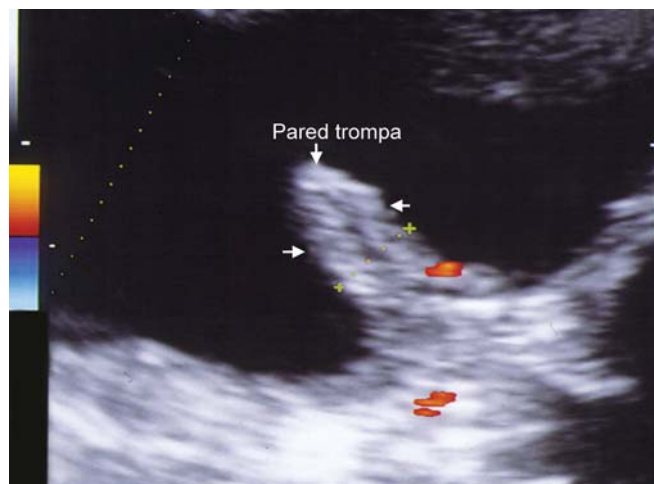
The diagnosis of initial acute PID (acute salpingitis)<sup>5</sup> begins with a challenge for the doctor, due to the little sensibility of the clinic's criteria. According to L Jacobson and L Westrom, the probability of fulfilling all of the major criteria is at 16.1%, the probability of fulfilling all of the major criteria and one minor is at 28.3%, and the probability of fulfilling all of the major criteria and two minor is at 38.7%.

It is difficult to diagnose a disease that includes an acute state and especially with these minimum findings that can cause relapses like infertility and complications like an ectopic pregnancy.

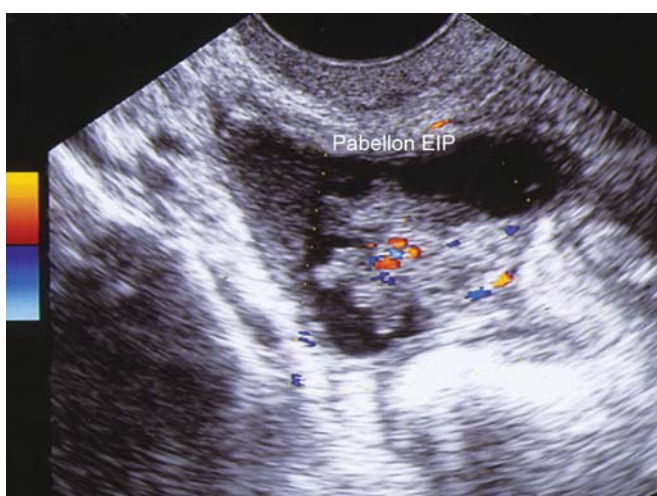
For this reason, the necessity arises to identify those signs in the ultrasonograms that create suspicion of



**Fig. 1:** The existence of interabdominal liquid permits a visual of the fallopian tube



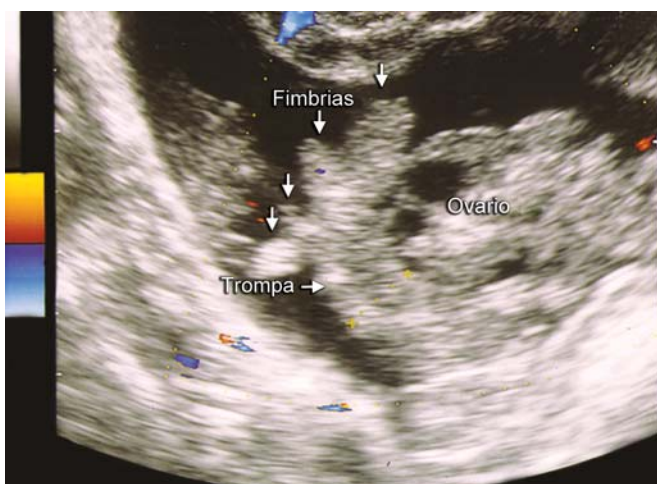
**Fig. 4:** Tubal tract. This image alone shows the presence of free liquid



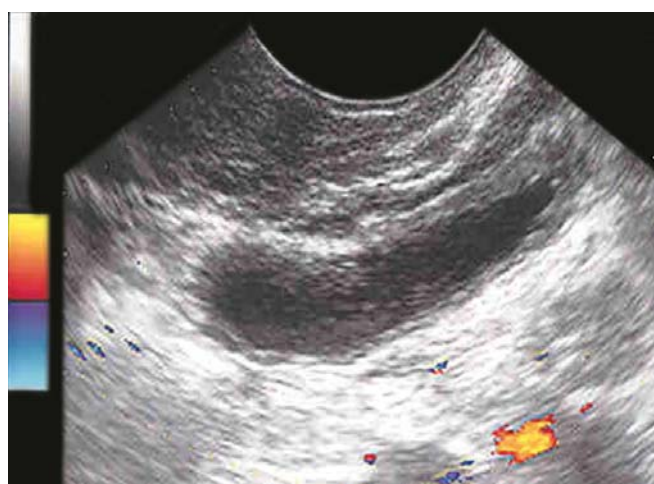
**Fig. 2:** Fallopian tube with liquid in the abdominal cavity



**Fig. 5:** Initial acute salpingitis. The fallopian tube can be seen when, due to inflammation, liquid is accumulated in the interior



**Fig. 3:** Tubal fimbrias. The surrounding liquid permits a visual of the outline of the fallopian tube



**Fig. 6:** Acute salpingitis. The fallopian tube with liquid in the interior and is dilated

salpingitis and that could direct us toward a more precise diagnosis, mainly in those cases of atypical pain and in those cases where the absence of treatment could provoke chronic

pain or cases of sterility that had been possible to avoid in the diagnosis and treatment processes. The CDC recommends the empirical treatment of those women who

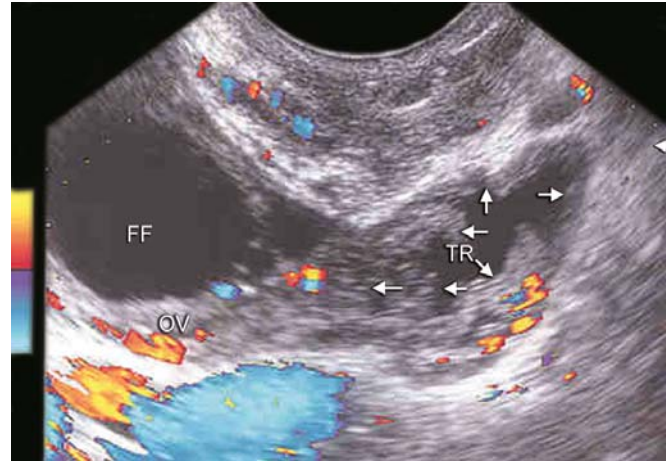


suspect PID and present the major diagnostic criteria, but this procedure allows us to use treatment processes that do not correspond with PID, with the morbidity that supposes an inadequate treatment.

The sonographic diagnosis of salpingitis is a threat for a sonographer. Acute salpingitis can begin with a diagnosis the moment in which the liquid is accumulated in the interior of the fallopian tube (Fig. 5) and is dilated (Fig. 6), signs that we can now detect with vaginal probe. In this moment, the restoration of suitable treatment can allow the case to be cured or to regress, with or without relapses, and already this inevitably is always unexpected.<sup>6</sup>

### Stage II: Salpingitis with Pelvipерitonitis

Two events mark the passage into this stage: The obvious engrossment of the fallopian tube and the free liquid inside the cavity. The fallopian tube is inflamed by the accumulation of the liquid in the interior, transudate in the



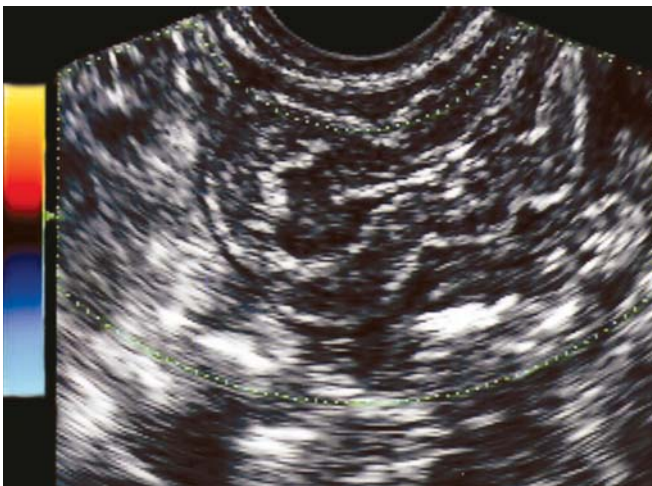
**Fig. 9:** Salpingitis with pelvipерitonitis. Stage II. Engrossed fallopian tube. Peritoneal irritation caused by the free liquid in the pelvis that surrounds the fallopian tube and is outlined well

tubal light (Fig. 7) or by the pronounced engrossment of all of the anatomy (Figs 8 and 9). In both cases, there is liquid in the peritoneal cavity. It is the image observed by the sonograph as sonolucence and the clinic translates it as Blumberg positive.<sup>7</sup>

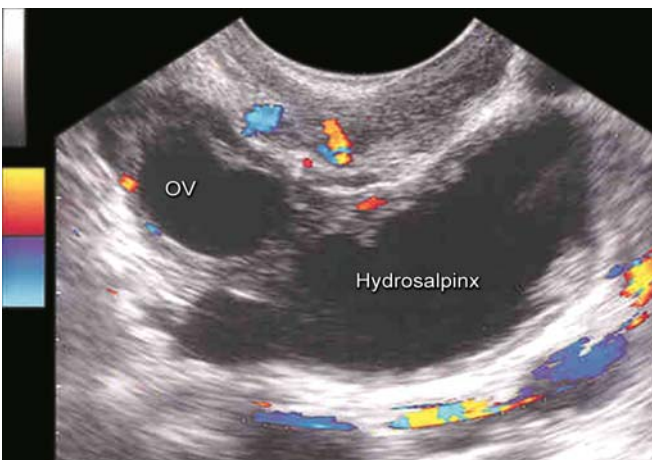
### Stage III: Tubal, Ovaric, Tubo-ovarian or Pelvic Abscess

The accumulation of pus inside the fallopian tube gives a location for the tubaric abscess or pyosalpinx, whose characteristic signal is the presence of purulent material in considerable quantities and is obviously visible by means of a sonograph inside the tubal light. But, in addition, there exists a series of characteristic sings that advise us:

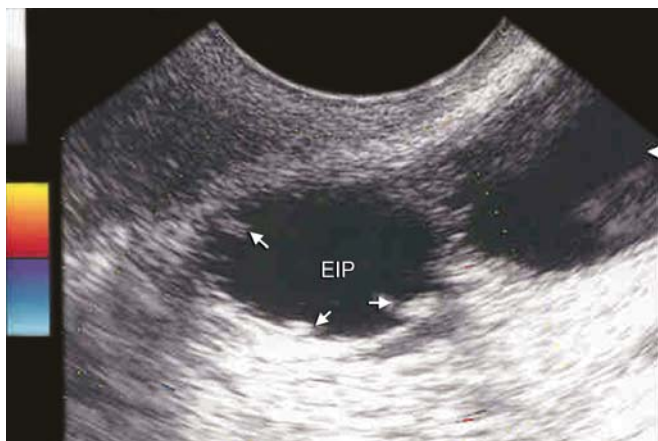
- ‘Beads-on-a-string’. The fallopian tube appears to be dilated, with excretions that project toward the interior of the light, of the same size and distribution. They are the expression of the destruction of the tubal mucus, whose folds leave a mold and they are perfectly visible by means of the vaginal sonograph (Figs 10 and 11).
- ‘Cogwheel’. The fallopian tube appears dilated with irregular excrescencies, and already disorganized, that are projected toward the interior light. They are signs of important destruction inside the fallopian tube with large contents of pus (Figs 12 to 14).
- ‘Incomplete septa’. It is an image of the pseudo-thin wall that does not arrive to occlude the complete tubal light. When the affected are seen in the inflammatory process, the fimbrias can provoke the fallopian tube to close. The exudate that is accumulated in the light can reach dilation of the fallopian tube in such a method that this folds over the same (Figs 15 to 17).
- ‘Wall thickness’. It is important to distinguish if the thickness of the tubal wall is larger or smaller than



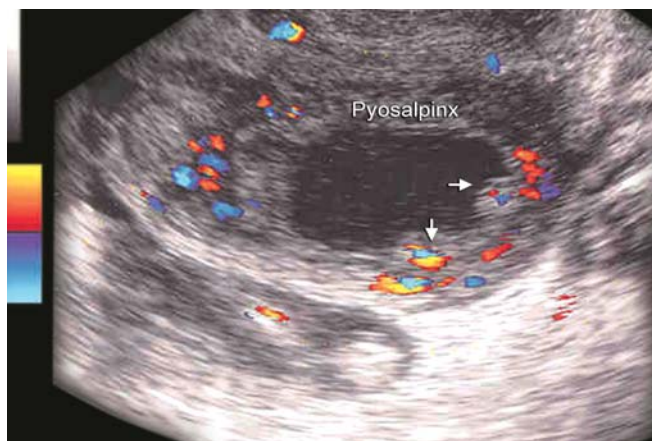
**Fig. 7:** Salpingitis with pelvipерitonitis. Stage II. Liquid in the interior and in the exterior of the fallopian tube



**Fig. 8:** Salpingitis with pelvipерitonitis. Stage II. Engrossed fallopian tube with liquid in the exterior, inside the pelvis



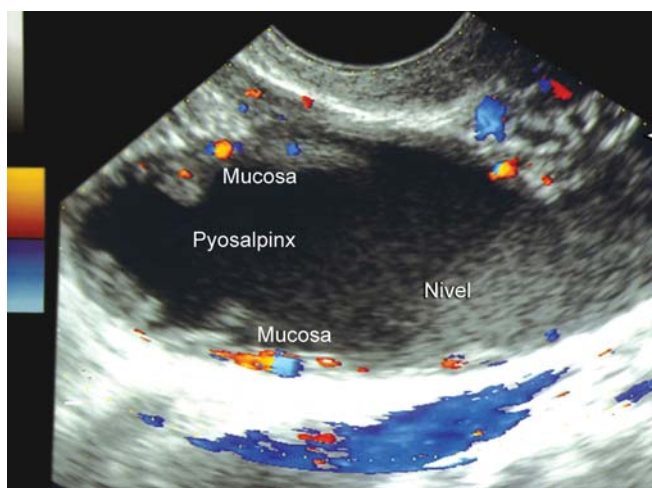
**Fig. 10:** Sonographic sign of 'Beads-on-a-string', evidence of a thin wall with few excretions of mucus in the interior



**Fig. 13:** Pyosalpinx—sign of 'Cogwheel'. Sonographic contents of pus



**Fig. 11:** Sonographic sign of 'Beads-on-a-string'. Two side views of the fallopian tube, where the mucal excretions appear



**Fig. 14:** Pyosalpinx—sign of 'Cogwheel'. Irregular excretions inside the tubal light



**Fig. 12:** Pyosalpinx—sign of the 'Cogwheel'. The excretions are distributed in irregular forms. Also, it has an image of a pseudo-thin wall

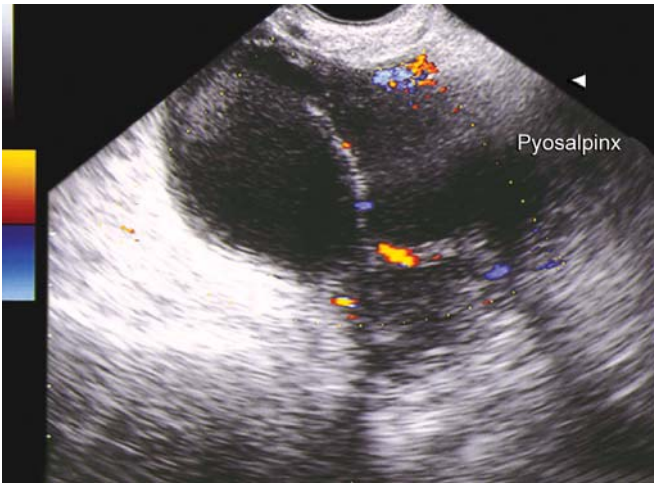


**Fig. 15:** Pyosalpinx—septa inside the fallopian tube that in reality is not without a fold in the fallopian tube

5 mm. The result of the thick wall follows the acute process, in those processes that are frequently present in the tubular edema (Figs 18 and 19). On the contrary, the finding of a thin wall can suggest tubal fibrosis.<sup>8</sup>

- 'Tubal contents'. In the pyosalpinx, there frequently is a mixed echogenicity or refringent, due to the purulent material (Fig. 20).
- 'Tubo-ovarian complex'. It is possible to recognize the fallopian tube and the ovary, but it is not possible to

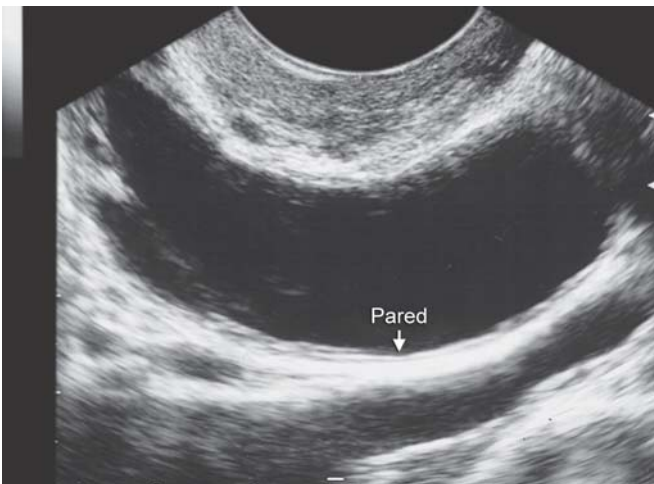




**Fig. 16:** Pyosalpinx—Incomplete septa. When the fallopian tube is dilated and is doubled, the wall provokes a sonographic sign of incomplete septa. Echorefringent material in the interior of the fallopian tube



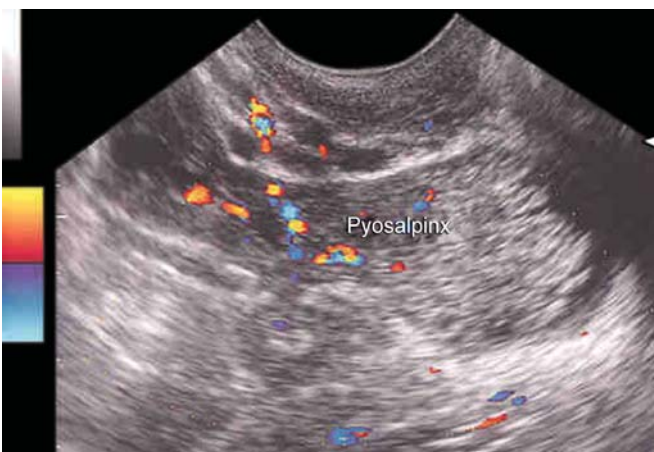
**Fig. 19:** Pyosalpinx—engrossment of the tubal wall that ends in the *cul de sac* through distal stenosis of the fallopian tube



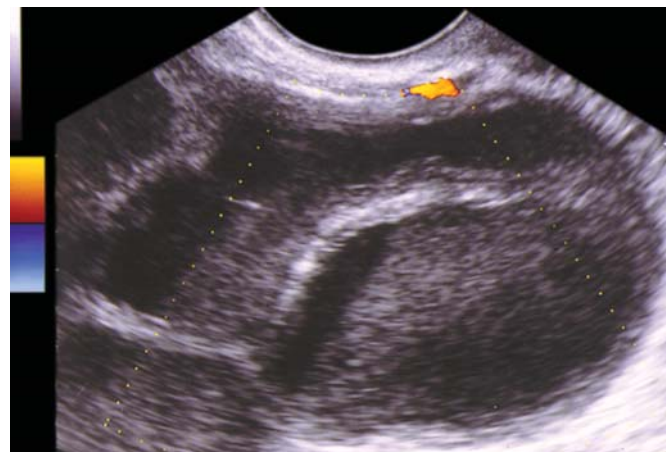
**Fig. 17:** Pyosalpinx—Incomplete septa. A sonographic sign of incomplete septa is important to identify the tubal origin of the complex anexial mass. Observe the destruction of the tubal wall



**Fig. 20:** Pyosalpinx—All signs. Refringent contents, pseudo-thin wall, excretions. Engrossment of the tubal wall



**Fig. 18:** Pyosalpinx—engrossment of the tubal wall that is characteristic of the acute process. Refringent material in its interior that indicates pus. The color map shows intense inflammation



**Fig. 21:** Tubo-ovarian abscess. Complex attachment in which we find the fallopian tubes surrounded as much as the ovary

**Table 3:** Laparoscopic classification of pelvic inflammatory disease

Acute	Erythema and edema of the fallopian tube
Moderate	Fallopian tubes with purulent excess
Severe	Pyosalpinx, tubo-ovarian abscess, tumor, inflammation

**Table 4:** Sonographic findings of pelvic inflammatory disease

	PID (n = 17)	False-positive (n = 3)
Thin wall of 5 mm	5 (29.4%)	0
'Cogwheel'	5 (29.4%)	0
'Beads-on-a-string'	5 (29.4%)	0
Incomplete septa	6 (35.2%)	1
Sonolucence contents	4 (23.4%)	2
Mixed contents	7 (41.1%)	2
Tubo-ovarian complex	4 (23.4%)	1

PID: Pelvic inflammatory disease

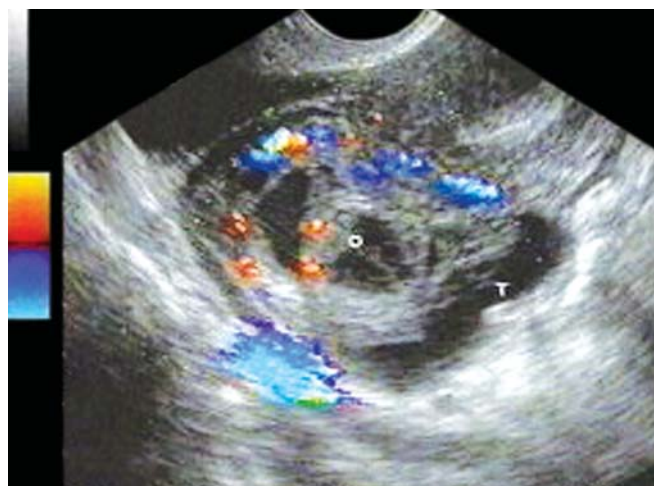
separate when we intend to differentiate the two with a vaginal probe. This could be due to the fibrous deposits that are formed<sup>9</sup> during the inflammatory process, which surrounds the fallopian tubes and attaches to the ovary (Figs 21 and 22).

According to our experience, the sign of incomplete septum and tubal contents of mixed echorefringence are the most characteristic findings of pyosalpinx and tubo-ovarian abscess. In Table 3, we show the frequency of those signs in our series, including the rare cases that we had on occasion to contrast the diagnosis for laparoscopy or laparotomy.

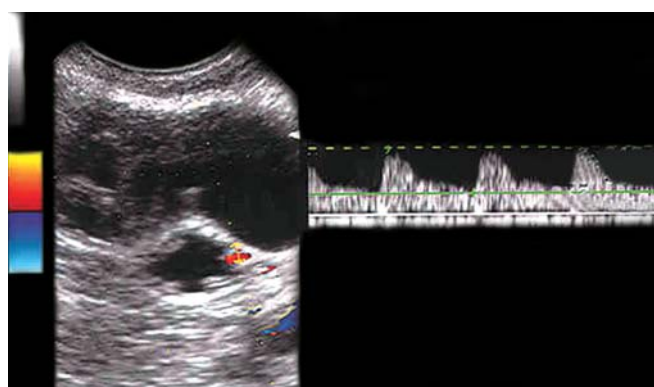
We believe that acute salpingitis generally runs without trouble or difficulty to the sonographic signs although it manifests pain in the adnexal exploration of the vaginal probe. If salpingitis is really acute, the fallopian tube dilates, providing evidence of an edematized, a thin wall is confirmed (a sign of 'cogwheel'), and it fulfils the generally mixed contents. If it evolves to tubo-ovarian abscess, the fallopian tubes are seen as very dilated and elongated to the ovary, that which is badly defined, with the signs of incomplete septa, mixed contents with levels and free liquids in the Douglas pouch (Table 4).

The color Doppler also contributes to the diagnosis that defines the inflammation that is characteristic of the acute process, but more irritation exists. Therefore, it detects more color signals in which the process already freezes (Figs 23 and 24).

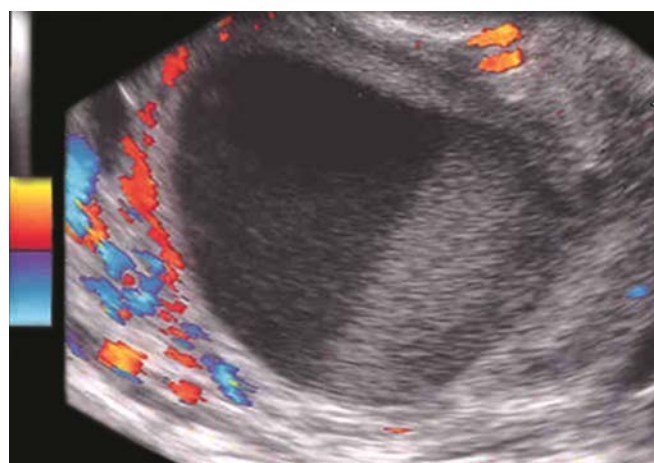
The fact that no control group is used, due to the characteristics of the disease and the impossibility to visualize the normal fallopian tubes sonographically, prevent us from obtaining the sensibility and actual specificity of the sonograph.



**Fig. 22:** Tubo-ovarian abscess. Tubo-ovarian complex in which is difficult to distinguish the borders of the ovary or the dilated fallopian tube



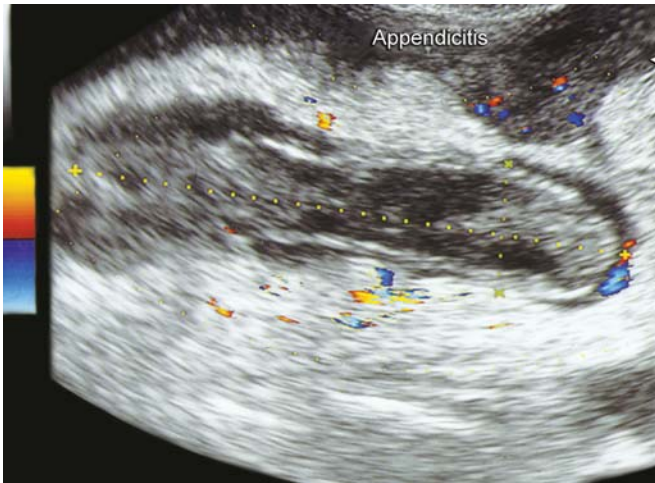
**Fig. 23:** Sign of color Doppler throughout the tube which suggests acute infection



**Fig. 24:** Abundant map color in the tubal wall with a very dilated fallopian tube. Suggestive of acute infection

Ultrasonography is very illustrative in the serious cases, and in the cases that are very acute, we put aside the processes with similar symptoms. The ability to explore with a vaginal probe attached permits us to perform a directed exploration, reaffirming the origin of the directed pain. It is important to recognize that acute appendicitis (Fig. 25) can





**Fig. 25:** Acute appendicitis. Inflamed and engrossed appendix with Doppler sign



**Fig. 27:** Accumulation of liquid in the cavity—endometriosis



**Fig. 26:** Endometriosis

have some symptoms and sonographic signs similar to those of acute salpingitis.

### ENDOMETRITIS

It has been confirmed that PID is an infection inside the pelvis that affects the feminine genital organs. It should be added that this occurs, generally, outside of the uterus. This is because the periodic menstrual desquamation most likely protects this organ. Obviously, this is not always the case and sometimes the uterus can be seen wrapped up in the process, producing endometritis and less frequently, myometritis. Since, this point can be seen from the sonographic view, the infection of the uterus can be manifested in two forms:

- The presence of refringent spotting that passes through all of the endometrial line (Fig. 26).
- The accumulation of liquid, translated in the sonolucence inside of the uterus cavity (Fig. 27).

### HYDROSALPINX

It is the most frequent result of PID. After an acute inflammatory or infectious process in any previous phase described, and with the adequate medical treatment, the process can be cured with the elimination of the aerobic germs and anaerobic causes of the disease. If acute salpingitis is treated, it can evolve with *restitutio ad integrum*, but immediately the disease finds itself a little more advanced, and concerning all the cases in stage III, this is not possible and we find our collections of liquid with germs inside the fallopian tube. This condition is known as hydrosalpinx. From the point of view<sup>10</sup> of the sonograph, the lengthened tubal structure is identified (Figs 28 and 29), with a fine wall of mucus atrophic (Fig. 30) and containing sonolucent (a typical characteristic) (Fig. 31). The lesions of tubal mucus will depend on the gravity of the process, but the contained sonolucent creates an acoustic window that permits a visual, even better, the signs described earlier, like the projected cases on the internal edge of hydrosalpinx (a sign of the ‘Beads-on-a-string’)<sup>11,12</sup> (Figs 32 and 33) or if the dilated fallopian tube reaches a sufficient size or is doubled in size (a sign of incomplete septa) (Figs 34 and 35).

### HYSTEROSALPINGOSONOGRAPHY

The principal proposal of hysterosalpingosonography concerning the tubal pathologies could be the substitution of hysterosalpingography in the analysis of the fallopian tubes. The published results are interesting and include authors like I Goldstein and H Y arali who have complemented their work with the use of the Doppler.<sup>13</sup> Nevertheless, the sonographic technology will provide less information about the morphology of the fallopian tube, its internal structure and the location of obstruction. The analysis of the latest articles about hysterosonography make it obvious that, in reality, the



**Fig. 28:** Hydrosalpinx—longitudinal view



**Fig. 31:** Hydrosalpinx—sonolucent contents. Few Doppler signs in the wall of the fallopian tube



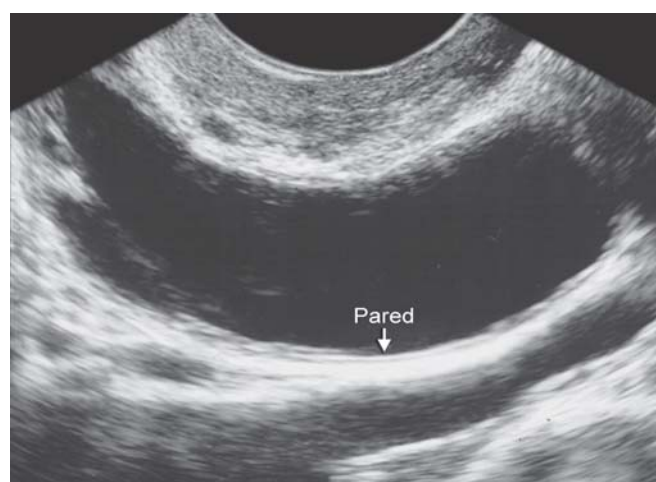
**Fig. 29:** Hydrosalpinx—sonolucent contents



**Fig. 32:** Hydrosalpinx—it remains a sign of 'Beads-on-a-string'. There is no activity in the wall. Practically no sign in the Doppler



**Fig. 30:** Hydrosalpinx—sonolucent contents. Tubal wall very thinned



**Fig. 33:** Hydrosalpinx—sonolucent formation. Sign of 'Beads-on-a-string'. Few Doppler signs

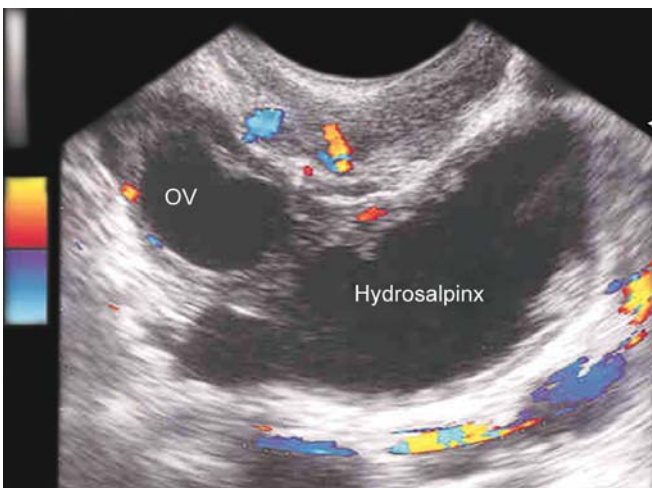
majority of the authors who use this technology in their analysis of intracavity pathology, still appeal to hysterosonography and chromopertubation like the specified technology to demonstrate the tubal permeability.<sup>14</sup> To verify

this last claim, it has to be assumed as the introduction of a liquid (serum saline or contrast sonograph) through the cervix (hysterosonography). By using this procedure, the passage of opposition or the free liquid in the peritoneal cavity can





**Fig. 34:** Hydrosalpinx—sonolucent formation. Pseudo-thin wall



**Fig. 35:** Hydrosalpinx—sonolucent. Detail of the pseudo-thin wall. Tubal mucus destroyed

be visualized, if it is permeable. However, its utilization has not been reached, because it will not provide the information of how this passage occurs and, therefore, hysterosalpingography cannot be substituted as a method of reference to validate the tubal pathology.

### SONOGRAPHIC DRAINAGE AS A GUIDE TO PELVIC ABSCESS PERFORATION

Traditionally, obstetricians and gynecologists, including those before the arrival of sonography, became accustomed to draining the pelvic abscesses that bulge convexly toward the vagina through the Douglas pouch, it became a route with which we were familiarizing ourselves and with the intention to alleviate the pus. Afterward, we have come to project this same idea with sonography on how to give a guide to perforation. In this prospective study published in 1996, in which we randomly selected 40 patients with pelvic

abscess to administer medical treatment with antibiotics without further procedure or with medical treatment in addition to abscess perforation by route of the vaginal tract with sonography. We found the latter method shared a much quicker recuperation and reduced the hospital stay, with statistically proven differences. Similarly, in the study group, a smaller number of laparotomies were necessary to provide a motive to use this process.<sup>15,16</sup> Recently, this pathology, whose incidences have diminished, begins a new as they are found in the clinics, perhaps the product of promiscuity and with attention to the emigrant population, for those who we believe that they have the technology that could result beneficially that is simple to perform and possess inherent few complications.

### REFERENCES

1. American College of Obstetricians and Gynecologists. Guidelines for Women's Health care. American College of Obstetricians and Gynecologists, Washington, DG 1996.
2. Anshu R Mohilaje, Kathy M Curtis, Herbert B Peterson. Does insertion and use of an intrauterine device increase the risk of pelvic inflammatory disease among woman with sexually transmitted infection? A systematic review. *Contraception* 2006;73:145-53.
3. Tngg BG, Kerndt PA, Aynalem G. Sexually transmitted infections and pelvic inflammatory disease in Women. *Med Clin N Am* 2008;92:1083-113.
4. Gjeffland K, Ekerhovd E, Granberg S. Transvaginal ultrasound-guided aspiration for treatment of tubo-ovarian abscess: A study of 302 cases. *Am J Obstet Gynecol* 2005;193:1323.
5. Grimes DA. Intrauterine device and upper-genital-tract infection. *Lancet* 2000;356:1013.
6. Gnmes DA, Schultz FK. Antibiotic profilaxis for intrauterine contraceptive device insertion. *Cochrane Database of Systematic Reviews* 2008.
7. Masters T, Everett S. Intrauterine and barrier contraception (a practical review of recent developments) *Current Obstetrics and Gynaecology* 2005;15:31-37.
8. Ness RB, Soper DE, Holley RL, et al. Effectiveness of inpatient and outpatient treatment strategies for women with pelvic inflammatory disease evaluation and clinical health (PEACH) randomized trial. *Am J Obstet Gynecol* 2002;186:929.
9. Peipert JF, Ness RB, Blume J, et al. Clinical predictors of endometritis in women with symptoms and signs of pelvic inflammatory disease. *Am J Obstet Gynecol* 2002;100:456.
10. Protopapas AG, Diakomanolis ES, Milingos SD, et al. Tuboovarian abscess in postmenopausal women: Gynecol malignancy until proven otherwise?. *Eur J Obstet Gynecol Reprod Biol* 2004;114:203.
11. Ross J, Stewart P. Management of acute PeMc inflammatory disease. Royal College of Obstetricians and Gynaecologists.
12. Savaris RF, Teixeira LM, Torres TG, et al. Comparing ceftriaxone plus azitromycin or Doxycycline for pelvic inflammatory disease: A randomized controlled trial. *Obstet Gynecol* 2007;110:53.

13. Stacey CM, Munday PE, Taylor-Robinson D, et al. A longitudinal study of pelvic inflammatory disease. *Br J Obstet Gynaecol* 1992;99:994.
14. US. Department of Health and Human Services Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2006 y 2007.
15. Washington AE, Katz R. Cost of and payment source for pelvic inflammatory disease. *JAMA* 1991;266:2565.
16. Workowski KA, Berman SM. Sexually transmitted diseases treatment guidelines. *MMWR Recomm Rep* 2006;55:1.

## ABOUT THE AUTHORS

### Jose Bajo Arenas (Corresponding Author)

Professor, Department of Obstetrics and Gynecology, Santa Cristina University Hospital, c/ Poniente 47 Pozuelo Alarcón Madrid 28223 Madrid, Spain, e-mail: jbajoa@sego.es

### Tirso Perez-Medina

Professor and Consultant, Department of Obstetrics and Gynecology Autonoma University of Madrid, Puerta de Hierro, Santa Cristina University Hospital, Madrid, Spain