CLINICAL TECHNIQUE

Is Laparoscopy Valuable for Detection of Distal Fallopian Tubal Peristalsis?

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Abstract

Objectives: To evaluate the usefulness of employing laparoscopy to observe distal fallopian tube (FT) peristalsis and to compare its efficacy to the hysteroscopic viewing of proximal FT peristalsis in normal and hydrosalpingeal FT.

Design: A prospective comparative cohort study.

Patients and methods: One hundred and fifteen infertile women undergoing concomitant diagnostic or operative laparoscopy and hysteroscopy were divided into two groups. Group A comprised 59 cases with apparently normal FTs while group B comprised 56 cases with hydrosalpingies.

Setting: Endoscopy unit of a tertiary university hospital.

Methods: Fallopian tube status was assessed during diagnostic or therapeutic laparoscopy, including whether morphologically normal and patent or not. Whenever possible, monitoring of the distal ends of both FTs was performed to detect any potential peristalsis. The proximal portions of each FT were then subjected to hysteroscopy to assess proximal tubal peristalsis. The effectiveness of laparoscopy in assessing distal FT peristalsis and comparing its findings to the hysteroscopic assessment of proximal FT peristalsis in normal and pathologic FT were the primary outcomes.

Results: Laparoscopic detection of distal tubal peristalsis either in normal or hydrosalpingeal FT was low [5 (4.2%) and 5 (4.4%)] in both groups, respectively. After the exclusion of cases with unilateral patent FT from group B, the percentage dropped to 3.2% (only three FT). Hysteroscopic detection of proximal tubal peristalsis was significantly higher in group A [80 (67.8%) vs 40 (35.7%)] in total group B.

Conclusions: Laparoscopic evaluation of distal FT peristalsis, whether for healthy or pathologic FT, is of limited utility and is not advised. Its effectiveness is significantly lower than the hysteroscopic evaluation of proximal FT peristalsis.

Keywords: Anatomy, Hysteroscopy, Hydrosalpinx, Laparoscopy, Peristalsis, Physiology.

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Introduction

Peristalsis, or the contractility of the fallopian tube (FT), is a recognized physiological phenomenon. For the proximal, middle, and distal sections, respectively, it may be continuous tonic contractions, brief periodic contractions, or a series of oscillating movements. It provides proper mixing of tubal secretions necessary for the gametes and embryo, acts as a functional gate at the utero-tubal junction and ampullary–isthmic junction, and aids in the oocyte pick-up process in the three parts, respectively.[1,2] It has been proven for a very long period in several animals,[3] experimental or *in vitro* human research.[4–6] Right now, it is accepted that FT patency testing is considered a tubal function test that includes peristalsis.[7] Numerous cases of infertility have been satisfactorily explained by gynecologic endoscopy in contemporary clinical practice.[8] Endoscopic visualization of proximal FT peristalsis is achievable utilizing office hysteroscopy.[9] The purpose of this study was to evaluate the utility of laparoscopy for distal FT peristalsis visibility in normal and hydrosalpingeal FT, and to compare outcomes to hysteroscopic detection of proximal FT peristalsis.

Patients and Methods

This is a prospective comparative cohort study done at the Endoscopy Unit of the Woman's Health Hospital, Assiut, Egypt, between December 10, 2019 and August 20, 2020. It was approved by the Assiut Medical School Ethical Review Board (#17101059) and was registered at ClinicalTrials.gov (ID: NCT03953586). It included infertile women in the reproductive age group subjected to combined laparoscopy and hysteroscopy to be done under general anesthesia due to different indications as previously recommended.[10] After proper counseling, informed written consent was taken from every case. Detailed clinical, sonographic, and radiologic assessments of all cases were similar to a previous study on the same cases.[11] Intraoperatively, patients were divided into two groups according to the laparoscopic appearance of the FT. If the FT was patent after a chromopertubation test, of normal size, length, integrity, external surface, and fimbriae; the patient was allocated in group A regardless of the existence, extent, and

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type of pelvic adhesions. On the other hand, if one or both FTs were distended with the dye and showed a characteristic increased tubal size with distal occlusion (hydrosalpinx), the patient was allocated in group B. Sustained observation of any rhythmic contractions and relaxation of the distal end for 1 minute was done to assess distal FT peristalsis. If FT was inaccessible, it would be grasped by atraumatic forceps and kept in place by elevation of the mesosalpinx of its middle part against the lateral pelvic wall while observing its distal end. At the end of the laparoscopic assessment, diagnostic hysteroscopy was done as previously described.[10] To properly visualize the proximal part of the FT by hysteroscopy, all procedures were done in the follicular phase. The corneal ends were meticulously evaluated to comment on Darwish hysteroscopic triad.[12] Darwish hysteroscopic triad is formed of a conical part of the FT seen by hysteroscopy. Its base is the ostium, its walls are converging first millimeters of the intramural part, and its summit is a distal pinhole dark spot representing the narrowest part of the FT. Darwish hysteroscopic triad was assessed for any anatomic abnormality and simultaneous visualization of rhythmic opening and closing (peristalsis) on maintained intrauterine pressure. The primary outcome was to estimate distal and proximal FT. The Statistical Program for Social Science version 24 was used to analyze the data. Quantitative data were expressed as mean ± SD. Qualitative data were expressed as frequency and percentage. The independent-sample *t*-test (T) and Mann–Whitney *U* tests were used to compare two means of normally and abnormally distributed data, respectively. The Chi-square test was used when comparing nonparametric data. Probability (*p*-value) < 0.05 was considered significant (S), < 0.001 was considered highly significant and > 0.05 was considered nonsignificant. All the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines were followed during the preparation of the manuscript.

Results

According to the laparoscopic status of the FT, two groups of infertile women who underwent concurrent laparoscopic and hysteroscopic evaluations of infertility were studied. Group A included 59 patients with apparently healthy FTs, while group B included 56 cases with unilateral or bilateral hydrosalpingies (swollen and distally obstructed FT). Sociodemographic information for both groups is shown in Table 1. Laparoscopic appearance and chromopertubation tests in both groups are seen in Table 2. Laparoscopic detection of distal tubal peristalsis either in normal or hydrosalpingeal FT was low [5 (4.2%) and 5 (4.4%)] in both groups, respectively, as demonstrated in Table 3. After the exclusion of cases with unilateral patent FT from group B, the percentage dropped to 3.2% (only three FT). Moreover, hysteroscopic detection of proximal tubal peristalsis was significantly higher in group A [80 (67.8%) vs 40 (35.7%)] in total group B. Table 4 shows diagnostic indices of hysteroscopic detection of proximal FT peristalsis in both groups.

Table 1: Basic preoperative data

Variables	*Group A (n = 59)*	*Group B (n = 56)*	*p-value*
Age (years) (mean ± SD)	25.90 ± 5.08	25.96 ± 4.81	0.943
Parity			
Nullipara	21 (35.6%)	19 (33.9%)	0.851
Para	38 (64.4%)	37 (66.1%)	
BMI (kg/m^2) (mean ± SD)	25.32 ± 4.64	25.59 ± 4.50	0.755
History of PID	5 (8.5%)	27 (48.2%)	0.000*
History of operation	18 (30.5%)	26 (46.4%)	0.079
Infertility			
Primary	22 (37.3%)	20 (35.7%)	0.861
Secondary	37 (62.7%)	36 (64.3%)	
Residence			
Urban	32 (54.2%)	30 (53.6%)	0.943
Rural	27 (45.8%)	26 (46.4%)	

*Highly significant

Discussion

The FT is a dynamic, paired organ[13] that responds to steroid hormones and has a sensitive anatomical, physiological, neurological, and histologic makeup. To aid in ovum pick-up and fertilization, a functional FT should be anatomically patent and physiologically active. It is interesting to note that there are two paradoxical peristalses of proximal and distal FTs that move in opposite directions to draw sperm and oocyte to the ampulla, respectively.[5,14] Intensifying the interface between hormones and nutrients and the eggs or embryos[15] is another role of FT peristalsis, which helps with proper fertilization as well as early embryo development and transportation.[16]

Tubal function assessment in clinical practice is entirely based on FT patency by various diagnostic techniques.[7] Additionally, some studies justified this by pointing out the limited technical accessibility and ethical constraints of invasive tests of tubal physiology.[17] Under the influence of several reproductive hormones, the contractility of circular and longitudinal strips from excised FT was evaluated *in vitro*.[18] However, there were not enough data to compare oviduct ciliary activity to muscle contraction in transit.[19] Trials of FT peristalsis *in vivo* measurements are rare. For example, it was done in some patients who underwent laparotomy or tubal occlusion repair. Throughout the whole menstrual cycle, they inserted two to three fluid-filled FT catheters to measure the peristaltic waves.[5] Utilizing straightforward, relevant, and useful technologies, more research on FT peristalsis is urgently required.[20] To the best of our knowledge, this work is the first to employ laparoscopy to visualize distal tubal peristalsis *in vivo*. Due to direct and simple access, laparoscopy is supposed to be suitable for this goal. Unfortunately, this study revealed a low rate of peristalsis in the FT that appeared to be normal and a very low rate in the FT that was pathological. This may be attributed to the detrimental effects of CO_2 gas on tubal physiology, which may result in the deterioration of the peritoneal (serosal) integrity[21] or a general anesthetic impact, including muscle relaxants, which is counteracted by regional anesthesia in other studies.[22] Another possibility is the postmenstrual period timing of all cases, which was suitable for proper hysteroscopic visualization of the proximal FT but not ideal for the observation of the distal section. To determine the precise percentage of distal peristalsis induced by progesterone, another study in the periovulatory period is needed. Without scientific support, there is a consensus that distal FT peristalsis would be evident at ovulation to help oocyte pickup. Additionally,

Table 2: Laparoscopic findings

	Group A (n = 59)		*Group B (n = 56)*		
	Right	*Left*	*Right*	*Left*	*p-value*
FT length					
Right					
Normal	45 (76.3%)	45 (76.3%)	10 (17.9%)	8 (14.3%)	0.000
Shortened but patent	14 (23.7%)	14 (23.7%)	2 (3.6%)	1 (1.8%)	
Hydrosalpinx	0 (0.0%)	0 (0.0%)	44 (78.6%)	47 (83.9%)	
FT width					
Right					
Normal	45 (76.3%)	45 (76.3%)	12 (21.4%)	9 (16.1%)	0.000
Distended	14 (23.7%)	14 (23.7%)	0 (0.0%)	0 (0.0%)	
Hydrosalpinx	0 (0.0%)	0 (0.0%)	44 (78.6%)	47 (83.9%)	
Peritubal adhesions					
Right					
No	35 (59.3%)	32 (57.1%)	32 (57.1%)	16 (27.1%)	0.972
Fine	16 (27.1%)	16 (28.6%)	16 (28.6%)	37 (62.7%)	
Extensive	8 (13.6%)	8 (14.3%)	8 (14.3%)	6 (10.2%)	
Positive perchromation test					
Right	59 (100.0%)	59 (100.0%)	11 (19.6%)	9 (16.1%)	0.000

Table 3: Laparoscopic and hysteroscopic peristalses

	Group A (118 FT)		*Group B (112 FT)*		*Group B (91 FT)*[a]		*Total positive test*		
	Right (59 FT)	*Left (59 FT)*	*Right (56 FT)*	*Left (56 FT)*	*Right (44 FT)*	*Left (47 FT)*	*Group A (118 FT)*	*Group B (112 FT)*	*Group B (91 FT)*[a]
Laparoscopic distal peristalsis test									
Positive	3 (0.05%)	2 (0.03%)	4 (0.07%)	1 (0.17%)	2 (0.04%)	1 (0.02%)	10 (8.4%)	2 (1.7%)	0 (0%)
Negative	56 (94.9%)	57 (96.6%)	52 (46.4%)	55 (98.2%)	42 (46%)	46 (50.5%)			
Hysteroscopic proximal peristalsis test									
Positive	42 (71.2%)	38 (64.4%)	24 (42.9%)	18 (32.1%)	6 (13.6%)	7 (14.9%)	80 (67.8%)	42 (37.5%)	13 (14%)
Negative	17 (28.8%)	21 (35.6%)	32 (57%)	38 (67.8%)	38 (86.3%)	40 (85%)			

[a]After exclusion of unilateral normal FT

Table 4: Diagnostic indices of different hysteroscopic tests in relation to laparoscopy

	True positive		*True negative*		*False positive*		*False negative*	
	Right	*Left*	*Right*	*Left*	*Right*	*Left*	*Right*	*Left*
Peristalsis (*n* = 115)	43 37.4%	39 33.9%	32 27.8%	38 33.04%	24 20.9%	18 15.7%	16 13.9%	20 17.4%

	Sensitivity		*Specificity*		*PPV*		*NPV*		*Accuracy*	
	Right	*Left*	*Right*	*Left*	*Right*	*Left*	*Right*	*Left*	*Right*	*Left*
Peristalsis	72.9% (59.7–83.6)	66.1% (52.6–77.9)	57.1% (43.2–70.3)	67.9% (54–79.7)	64.2% (56.1–60.7)	68.4% (58.7–76.8)	66.7% (55.4–76.3)	65.5% (56–73.9)	65.2% (55.8–73.9)	66.9% (57.6–75.4)

NPV, negative predictive value; PPV, positive predictive value

group B failed to visualize peristalsis due to the negative effects of hydrosalpingeal fluid.[23]

This study's limitations include its relatively small sample size (because of the rarity of cases of hydrosalpinx), use of general anesthesia, and selection of the postmenstrual phase for hysteroscopic optimal imaging of the proximal region of the FT. This study's findings support the conclusion that laparoscopic evaluation of distal FT peristalsis, whether for healthy or pathologic FT, is of limited utility and is not advised. Its effectiveness is significantly lower than the hysteroscopic evaluation of proximal FT peristalsis.

Author Contributions

Atef Darwish conceptualized this study, performed all operations, wrote and revised the study. Dina Darwish collected data and revised the study.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethical Approval

The author(s) have obtained written informed consent from the patients for publication of the case details. The Assiut Medical School Ethical Review Board approved the study protocol (#17101059).

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