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Original Research Article

Spectrum of Tubal Factors Contributing to Infertility: A Laparoscopic Analysis

Ananya Ratna Preya[1], Rashmi Prasad[2]

[1]MCh 1st year resident, Department of Reproductive medicine and surgery, Mahatma Gandhi Medical College, India

[2]Infertility specialist, Diwya Vatsalya Mamta Fertility Centre, Patna, Bihar, India

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Corresponding Author: Dr. Ananya Ratna Preya

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Abstract:

Background: Tubal factor infertility constitutes a considerable percentage of female infertility, and precise evaluation of tubal disease is crucial for efficient treatment. Laparoscopy is the definitive method for assessing tubal patients and related pelvic anomalies.

Aim: To evaluate the prevalence and pattern of tubal factors in infertile women using laparoscopic assessment and to correlate findings with the type of infertility.

Methodology: This prospective observational study involved 70 women aged 20 to 40 years with primary or secondary infertility, conducted at a tertiary care facility. All participants underwent diagnostic laparoscopy with chromopertubation. Tubal patency, morphology, and associated pelvic pathologies were documented and analyzed using descriptive statistics and chi-square tests.

Results: Laparoscopy revealed tubal pathology in 60% of cases. Unilateral tubal block was seen in 14.3%, bilateral block in 17.1%, hydrosalpinx in 11.4%, and peritubal adhesions in 17.1% of women. Primary infertility was more commonly associated with bilateral tubal block, whereas adhesions were more frequent in secondary infertility.

Conclusion: Tubal factors contribute substantially to female infertility. Laparoscopic evaluation provides comprehensive diagnostic information and aids individualized management planning.

Keywords: Infertility, Tubal factors, Laparoscopy, Chromopertubation, Primary infertility, Secondary infertility.

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Introduction

Infertility is a major health issue across the globe with the prevalence being found in about 10-15 percent of reproductive couples. It can be explained as the failure to get pregnant due to 12 months of frequent unprotected sex. Infertility has multifactorial causes, including male, ovulatory, uterine and tubal pathologies [1]. Among them, tubal factor infertility is one of the most significant contributors as it covers almost 2535 percent of female infertility cases. Fallopian tubes may also be damaged, and this may hinder the movement of the oocytes, sperm, or an embryo, thus preventing fertilization and implantation [2]. It is thus important to know how tubal factors contribute to proper diagnosis and treatment of infertile couples.

Fallopian tubes are involved in the reproductive process in a critical way because they help in the capture of the ovulated oocyte, fertilization location, and the action to carry the fertilized embryo to the uterine cavity [3]. Tubal damage may be caused by several factors, such as pelvic inflammatory disease (PID), endometriosis, pelvic or abdominal surgery, or sexually transmitted infections. Moreover, tubal dysfunctions can also be impaired due to congenital abnormalities as well as peritubal adhesions [4]. Since the fallopian tubes are vital in fertility, the proper assessment of tubal integrity and patency should be included in the assessment of infertile women.

Conventionally, there are various diagnostic interventions that have been used to determine tubal patency which include hysterosalpingography (HSG), sonohysterography, and chromopertubation during laparoscopy [5]. Hysterosalpingography, i.e. radiopaque contrast to visualize fallopian tubes and uterine cavity, has been extensively used because it is easy and noninvasive. It, however, is restrained by false-positive and false-negative outcomes and lacks details concerning peritubal adhesions and pathology of the pelvis [6]. Sonohysterography has comparable benefits and drawbacks.

Laparoscopy is considered the gold standard for evaluating tubal variables in infertility. It gives

direct visualization of organ of the pelvis, whereby tubal patency, tubal morphology, pelvic adhesions, endometriosis, and other intra-abdominal abnormalities could be assessed at the same time [7]. Another highly accurate way of assessing the patency of fallopian tubes is laparoscopic chromopertubation where colored dye is injected into the uterine cavity and is then seen passing through the fallopian tubes. The method does not only confirm the existence of obstruction of the tubes but also reveals the slightest peritubal disease that cannot be identified using imaging methods alone [8].

There are several studies that have been done to show the value of laparoscopic assessment in the management of infertile couples. Laparoscopy enables the delivery of specific therapeutic interventions, including adhesiolysis, ablation of endometriotic lesions, or salpingostomy to enhance the results of fertility [9] because it offers a thorough evaluation of the anatomy of the pelvis. Additionally, it is important to detect tubal pathology at the initial stage to inform the patients about the assisted reproductive technologies (ART) including in vitro fertilization (IVF) in case it cannot be surgically corrected or will not be effective.

Although laparoscopy has been embraced, due to the perceived importance of technology, there is still controversy about when laparoscopy should be used during infertility work-up, especially in work environments with limited resources. The selection of patients is essential to weigh the advantages of conclusive diagnosis and the possible therapeutic treatment with the dangers and expenditures of an invasive procedure. This paper will assess the prevalence and the nature of tubal factors in infertile women through laparoscopic evaluation thus giving an insight on how laparoscopy contributes towards full evaluation and management of infertility in women.

Methodology

Study Design: This research is a prospective observational study designed to examine tubal variables in infertility using laparoscopic evaluation.

Study Area: The research was performed in the Department of Reproductive Medicine and Surgery at Mahatma Gandhi Medical College, India.

Study Participants

Inclusion Criteria

- Women of reproductive age (20–40 years) presenting with primary or secondary infertility.
- Patients with normal hormonal profiles and no contraindications to laparoscopy.
- Patients who are granted informed consent for laparoscopic assessment.

Exclusion Criteria

- Women with known pelvic malignancy or severe systemic illness.
- Patients with a history of extensive pelvic surgery contraindicating laparoscopy.
- Women refusing consent for laparoscopic evaluation.

Sample Size: A total of 70 infertile women fulfilling the inclusion criteria were enrolled in the study.

Procedure: Upon securing informed consent, all participants had a comprehensive medical history and clinical assessment, succeeded by pertinent baseline investigations. Laparoscopy was conducted under general anaesthesia employing conventional procedures. A pneumoperitoneum was established, and a laparoscope was inserted to assess the pelvic organs, focusing specifically on the uterus, fallopian tubes, and ovaries. Tubal patency was assessed using chromopertubation with methylene blue dye. Findings such as tubal blockage, adhesions, endometriosis, and other pelvic pathologies were carefully recorded. Appropriate surgical interventions were performed if indicated, and all observations were documented systematically.

Statistical Analysis: The acquired data were input into Microsoft Excel and analyzed utilizing SPSS version 27. Descriptive statistics were employed to encapsulate demographic and clinical variables. Categorical data were expressed as frequencies and percentages, and the relationships between tubal pathology and clinical factors were examined using the chi-square test. A p-value of less than 0.05 was deemed statistically significant.

Result

Table 1 indicates the study population is 70 individuals with majority of the age group falling between 25 and 29 years (35.7%), then between 30 and 34 years (28.6%), under 25 years (21.4) and 35 years and above (14.3). Most of the participants had had 2–5 years of infertility (50%), 28.6% of less than 2 years of infertility, and 21.4% of more than 5 years of infertility. As to the type of infertility, most of the respondents were primary infertile (64.3) and only 35.7% were secondary infertile. Overall, the population consisted of young adults with the dominance of primary infertility and middle period of infertility.

Table 1: Demographic Profile of Study Population (n = 70)		
Parameter	**Number (n)**	**Percentage (%)**
Age (years)		
< 25	15	21.4
25–29	25	35.7
30–34	20	28.6
≥ 35	10	14.3
Duration of Infertility		
< 2 years	20	28.6
2–5 years	35	50
> 5 years	15	21.4
Primary vs Secondary Infertility		
Primary	45	64.3
Secondary	25	35.7

Table 2 shows that the laparoscopic assessment of the 70 patients showed that 40 percent of the patients had normal fallopian tubes and the rest 60 per cent had various tubal pathologies. Unilateral tubal block was observed with 14.3 percent and bilateral tubal block with 17.1 percent showing partial and complete obstruction in a considerable percentage. Hydrosalpinx, which is fluid-filled distended tubes, was detected in 11.4% of the patients. Also, the presence of adhesions at the sides of the tubes that could disrupt the work of the tubes was observed in 17.1% of adults and is a significant percentage of structural abnormalities that might cause infertility.

Table 2: Laparoscopic Findings – Tubal Factors (n = 70)		
Tubal Factor	**Number (n)**	**Percentage (%)**
Normal Tubes	28	40
Tubal Block (Unilateral)	10	14.3
Tubal Block (Bilateral)	12	17.1
Hydrosalpinx	8	11.4
Adhesions around tubes	12	17.1

Table 3 shows the side-specifics of the distribution of tubal pathology of 70 cases. In 15 subjects, that is, 21.4 of the totals, the right Fallopian tube was affected, and in 10 subjects, or 14.3, the left tube had been affected. The bilateral involvement involving both tubes was seen in 12 patients and this is equivalent to 17.1 percent. This shows that unilateral tubal pathology is predominant over bilateral with the right tube affected a little more than left.

Table 3: Side Involvement in Tubal Pathology (n = 70)		
Side	**Number (n)**	**Percentage (%)**
Right tube	15	21.4
Left tube	10	14.3
Both tubes	12	17.1

Table 4 illustrates how different tubal factors are spread between women with primary and secondary infertility. Out of the 45 women with primary infertility, 18 possessed normal tubes, whereas 27 possessed an abnormality; 6 had unilateral tubal block, 10 had bilateral block, 6 had hydrosalpinx, and 5 had adhesions. Conversely, out of the 25 women who were infertile secondary, 10 contained normal tubes, and the rest 15 were tubes with abnormalities: 4 unilateral block, 2 bilateral block, 2 hydrosalpinx and 7 adhesions. Overall, tubal block, particularly bilateral, was more prevalent in primary infertility with adhesions being comparatively more prevalent in secondary infertility being an indication of different patterns of tubal pathology between the two types of infertility.

Table 4: Correlation of Tubal Factors with Type of Infertility		
Tubal Factor	**Primary Infertility (n=45)**	**Secondary Infertility (n=25)**
Normal Tubes	18	10
Tubal Block (Unilateral)	6	4
Tubal Block (Bilateral)	10	2
Hydrosalpinx	6	2
Adhesions	5	7

Discussion

The study involved 70 young adult participants, with the majority (35.7% of the sample) aged 25-29 years, followed by those aged 30-34 years (28.6%). The number of participants below 25 years of age constituted 21.4, and those who were above 35 years comprised 14.3 percent of the population. This age group coincides with the normal reproductive age group where infertility studies are conducted the most. Most of the participants had an intermediate duration of infertility with half having infertility of 2-5 years, one-fourth having 28.6 years and the remaining one-fifth having 21.4 years. This implies that most of the people consulted at once a moderate time have elapsed, after numerous failed attempts at conception, as it is in normal clinical practice. Ikechebelu & Mbamara (2011) [10] reported that 39.5% of women exhibited typical patent tubes, while 60.4% presented with tubal diseases, including bilateral tubal occlusion in 38.3% and unilateral tubal occlusion in 22.1% of women.

Regarding the type of infertility, primary infertility was more common with 64.3% of the participants affected whereas secondary infertility was recorded in 35.7. Such preponderance of primary infertility is noteworthy, because this could represent structural or functional reproductive dysfunction that has led to conception in the past does not because that arise following a successful previous pregnancy. The demographic characteristic, as such, suggests that the study was mainly based on young adults who were more inclined towards primary infertility and intermediate infertility duration. Aziz et al., (2010) [11] demonstrated 1 case (3.1%) of primary infertility and 2 cases (16.7%) of secondary infertility. The predominant findings were 7 (21.9%) cases of tubal obstruction in primary infertility and 6 (33.3%) cases in secondary infertility.

Laparoscopic examination showed that 60 percent of the participants had some type of tubal pathology and this showed the relevance of tubal aspects in infertility. 14.3 had unilateral tubal block, 17.1 had bilateral tubal block, 11.4 had hydrosalpinx and 17.1 had adhesions around tubes. Normal tubes were found in only 40 per cent of the patients. These results show that the structural abnormalities involved in the fallopian tubes are very high and fallopian tubes are essential in the transportation of Gametes and fertilization. The high rates of unilateral and bilateral obstruction highlight the importance of obstruction in the infertility of females. In a comparative study of hysterosalpingography and laparoscopy, Robabeh & Roozbeh (2012) [12] determined that laparoscopy should be employed just in instances of suspected aetiologies other than intratubal factors (e.g., endometriosis and peritubal adhesions), notwithstanding its status as a reference standard in in infertility evaluation.

According to the analysis of the side-specific involvement, the case analysis revealed that unilateral-tubal pathology occurred more frequently than bilateral-tubal, with the right tube at 21.4% and the left tube at 14.3%. 17.1% were bilaterally involved. Such minimal right-sided dominance may result either due to anatomical, vascular, or inflammatory, differences but the clinical consequences remain the same: any obstruction of the tubes may result in hindering fertility. These findings indicate that critical inspection of both tubes is crucial when assessing laparoscopically. In primary infertility, kanal and Sharma, (2006) [13] recorded tubal blockage in 42.5 percent.

In making the correlation of the tubal pathology and the kind of infertility, clear patterns were noted. The most prevalent abnormality in primary infertility was bilateral tubal block which was seen in 10 out of 45 women and then unilateral block, hydrosalpinx and adhesions. Conversely, bilateral block and hydrosalpinx were not very common and adhesions were the most common finding among women with secondary infertility (7 out of 25). This indicates that primary infertility is more commonly linked with intrinsic tubal impaction, compared to secondary infertility which can be caused more frequently by acquired pathologies like adhesions in the pelvic cavity and this may be because of previous pregnancies or surgeries or even due to prior infections. Gupta et al., (2007) [14] investigated laparoscopic outcomes in genital tuberculosis at 47.1%. The varied outcomes of laparoscopy included peritoneal tubercles (12.9%), ovarian involvement (1.2%), tubovarian masses (7.1%), caseous nodules (5.8%), and encysted ascites in 7.1% of women. Pelvic adhesions of varying degrees were identified in 65.8% of women.

Generally, the research demonstrates the important role of tubal factors in infertility among the population. The high rate of both unilateral and bilateral tubal malformations as well as the dissimilarity in distribution of pathologies between primary and secondary infertility underlines the significance of timely and precise laparoscopic assessment. The identification of these patterns can inform clinicians to make specific management choices, including tuboplasty, adhesiolysis, or assisted reproductive technologies, to meet nature and degree of tubal pathology. These results support the necessity to use individual strategies to maximize reproductive potential.

Conclusion

This research paper has indicated that tubal causes of infertility in women are significant with 60 percent of women considered having some type of tubal pathologic evidence on laparoscopy. Bilateral and unilateral tube blockages, hydrosalpinx and peritubal adhesions were frequent, prompting the need to

pay attention to a comprehensive tubal evaluation. Primary infertility had closer links with intrinsic tubal obstruction especially bilateral block, whilst secondary infertility had stronger links with adhesions as possible acquired pelvic pathology. Laparoscopy was also found to be an effective diagnostic modality as it offers a thorough assessment of tubal patency and pelvic anatomy besides having the possibility of performing a simultaneous therapeutic intervention. The correct and timely laparoscopic examinations can thus serve as guides towards personalized management approaches and enhance the fertility rates.

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