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Role Of Transvaginal Ultrasonography In Assessment Of Uterine And Adnexal Factors Of Infertility

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ORIGINAL ARTICLE

Role of Transvaginal Ultrasonography in the Assessment of Uterine and Adnexal Factors of Infertility

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Abstract

Background: **There are many categories of female infertility factors, including those related to the cervix or the uterus, ovary, tubal, as well as others.**

Aim: **Our study aimed to evaluate the role of transvaginal ultrasonography (TVUS) in female infertility diagnosis. Ultrasound is becoming a crucial component of current female infertility examinations and assisted conception treatments.**

Patients and methods: **In all, 100 cases of infertility at Al-Azhar University Hospital and Damanhour Teaching Hospital were selected based on clinical diagnosis, ultrasonographic and laboratory findings. The cases were examined by TVUS to define the cause of infertility.**

Results: **Our results showed that on performing TVUS for all women in the study, 12 (12 %) of them were free 'without evident cause'; 22 % had fibroid by different types; 5 % showed endometrial polyps 'suspecting adenocarcinoma; ' 12 % had hydrosalpinx of fallopian tubes; 6 % postappendectomy; 4 % post-cesarean section; and 2 % had postovarian cystectomy; 8 % of cases had chocolate cyst 'endometriosis,' 2 % of cases had congenital anomaly; and finally 39 % of cases had polycystic ovary.**

Conclusion: **From this study, we can conclude that TVUS examination is beneficial in the diagnosis of uterine and adnexal diseases that can cause infertility in women. So, we recommend the use of TVUS examination during diagnostic procedures for uterine and adnexal factors for its beneficial effects in female infertility.**

Keywords: Primary infertility, Secondary infertility, Transvaginal ultrasonography

1. Introduction

The desire for reproduction is a universal phenomenon. WHO has defined infertility as the failure to get pregnant after more than a year of unprotected sexual practice. Ultrasonography has become a well-established technique for imaging ovarian and uterine pathologies. Etiology of infertility could be due to male or female factors. In this study, we clarify the female factors causing infertility that can be diagnosed by transvaginal ultrasonography (TVUS). Female infertility factors are classified into numerous categories, including those related to the uterus, ovaries, tubal, and others.[1]

Uterine factors, which can be congenital or acquired, account for 2–5% of all cases of infertility. The development of the Müllerian ducts is responsible for the normal anatomical configuration of the uterine, fallopian tubes, cervical, and upper vaginal. Congenital Müllerian abnormalities range from complete uterine and vaginal absence to mild malformations like arcuate uterine and vaginal septa.[2]

Any instrumentation of the endometrium cavity that results in adhesions of intrauterine or synechiae

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with partial or complete obliteration of the cavity is considered an acquired defect. Uterine fibroids are extremely prevalent, impacting between 25 and 50 % of women. They can cause cavity distortion and implantation failure.[2]

Altered menstrual cycle's frequency and duration is known as ovulatory dysfunction. Typically, a menstrual cycle lasts from 21 to 35 days, with 28 being the average. One of the most prevalent problems with infertility is ovulatory failure. It could be connected to oligomenorrhea, secondary amenorrhea, or primary amenorrhea.[3]

The absence of a spontaneous menstrual cycle by the age of 14 years with secondary sexual traits or by the age of 16 without secondary sexual traits is referred to as primary amenorrhea. Primary amenorrhea can be due to hypergonadotropic hypogonadism or hypogonadotropic hypogonadism. Congenital uterine, vaginal, or hymen absence is one of the structural abnormalities connected to primary amenorrhea (cryptomenorrhea).[4]

Secondary amenorrhea is defined as the absence of menstruation for more than 3 months in women who have regular menstruation or 6 months in women who have irregular menstruation.

Oligomenorrhea is the most frequent ovulatory disorder linked with infertility and is caused by hypothalamic–pituitary–ovarian axis dysfunction. Obesity is usually linked to the disease and worsens the prognosis.[3]

The fallopian tubes serve a crucial function in reproduction. Following ovulation, the oocyte is picked up by the fimbriae and transported to the ampulla by the epithelial cilia. The ampulla, where fertilization takes place, receives the spermatozoa from the endometrium. The embryo begins to cleave early and is then driven upward until it reaches the endometrial cavity. Pregnancy is hampered by any fallopian tube abnormalities or damage, such as PID, hydrosalpinx, elective tubal ligation, and salpingectomy.[5]

Infertility may result from physiological dysfunctions or anatomical defects of the peritoneal cavity, such as infections, adhesions, and adnexal masses. PIDs, peritoneal adhesions secondary to pelvic surgeries, endometriosis, and ruptured ovarian cysts all impair fallopian tube motility or result in fimbriae obstruction. Large myomas and pelvic masses interfere with peritoneal fluid accumulation and the normal oocyte pickup mechanism.[6]

The purpose of this research was to assess the role of TVUS in the assessment of uterine and adnexal infertility factors.

2. Patients and methods

This has been an observational prospective study performed on 100 women, who were referred to the Damanhour Teaching Hospital Obstetrics and Gynecology Department's outpatient clinics and were diagnosed as infertile, whether primary or secondary, during the period from February 1 to August 31, 2022.

After approval of the local ethics committee, all patients included in the study or their relatives were informed well about the procedure and had an informed written consent before carrying the procedure.

All women were subjected to complete history and clinical examination; laboratory hormonal assay follicle-stimulating hormone (FSH), luteinizing hormone (LH), FSH/LH ratio, estradiol, testosterone, prolactin, thyroid-stimulating hormone, etc. and radiological examination by ultrasonography transvaginally for the evaluation of uterine and adnexal factor for infertility.

Type of ultrasonography was VINNO X2.

Data were analyzed using corresponding statistical tests in SPSS, version 16 software (SPSS Inc., Chicago, Illinois, USA), with P values of less than 0.05 being considered significant.

2.1. Inclusion criteria

Women in the fertile age group and women who failed to conceive over 12 months.

2.2. Exclusion criteria

Women using any kind of contraception, women with interrupted sexual practice, lactating women, women with known medical conditions causing infertility, pregnant women, and postmenopausal women.

This study's sample size was calculated based on a study carried out by Ubaldi et al.,[7] considering the following assumptions: 95 % two-sided confidence level, with a power of 80 % and an α error of 5 %. The final maximum sample size taken from the output was 98. Thus, the sample size was increased to 100 participants to assume any drop out cases during the follow-up:

$$\left(\frac{Z_{a/2}+Z_B}{P_1-P_2}\right)^2 (p_1q_1+p_2q_2)$$

n = the sample size.

Z $a/2$: the critical value that divides the central 95 % of the Z distribution.

ZB: the critical value that divides the central 20 % of the *Z* distribution.
*p*1 = accuracy prevalence in the TCD group.
*p*2 = accuracy prevalence in the FL group.

3. Results

Table 1 showed that the overall age ranged between 20 and 39 years with a mean of 26.97 ± 4.7 years. The weight of women ranged between 48 and 87 kg with a mean weight of 61 ± 8.3 kg; the height of women ranged between 154 and 176 cm with a mean height of 162 ± 5.8 cm; and the overall BMI ranged between 28 and 42 kg/m^2 with a mean of 35.36 ± 2.89 kg/m^2 (Table 1, Fig. 1). The serum level of fasting blood sugar) ranged between 77 and 156 mg/dl with a mean of 107.1 ± 22 mg/dl.

Table 2 shows that the overall duration of marriage ranged between 2 and 7 years with a mean of 3.9 ± 1.12 years. The overall period of infertility ranged between 1 and 5 years with a mean of 2.56 ± 1.051 years. Fifty-six of our cases (56/100, 56 %) had primary infertility and the remaining 44 (44/100, 44 %) had secondary infertility; and the statistical analysis revealed a nonsignificant difference between both types of infertility regarding occurrence in our group of patients ($P = 0.541$) (Figs. 2 and 3).

Table 3 shows the findings from TVUS conducted on women in the study, 12 were free 'without evident cause' (12/100, 12 %); 22 women (22/100, 22 %) had fibroids of different types; five cases (5/100, 5 %) showed endometrial polyps 'suspecting adenocarcinoma,'; 12 (12/100, 12 %) had hydrosalpinx of fallopian tubes 'six cases with 6 % post-appendectomy, four (4 %) cases post-CS and two (2 %) cases with postovarian cystectomy, eight of our cases (8/100, 8 %) had chocolate cyst 'endometriosis,' two of our cases (2/100, 2 %) had congenital anomaly in the form of septate uterus, and finally 39 of our cases (39/100, 39 %) had polycystic ovary and the statistical analysis revealed that polycystic ovary cases were the most

Table 1. Demographic data of patients of both groups.

Variables	Range	Mean ± SD
Age (years)	20–39	26.97 ± 4.7
Fasting blood sugar (mg/dl)	77–156	107.1 ± 22
Weight (kg)	48–87	61 ± 8.3
Height (cm)	154–176	162 ± 5.8
BMI (kg/m^2)	28–42	35.36 ± 2.89

Table 2. Fertility data of patients of the study.

Variables	Range	Mean ± SD
Period of marriage (years)	2–7	3.9 ± 1.12
Period of infertility	1–5	2.56 ± 1.051
Type of infertility [*n* (%)]		
Primary	56 (56)	
Secondary	44 (44)	
P	0.541	

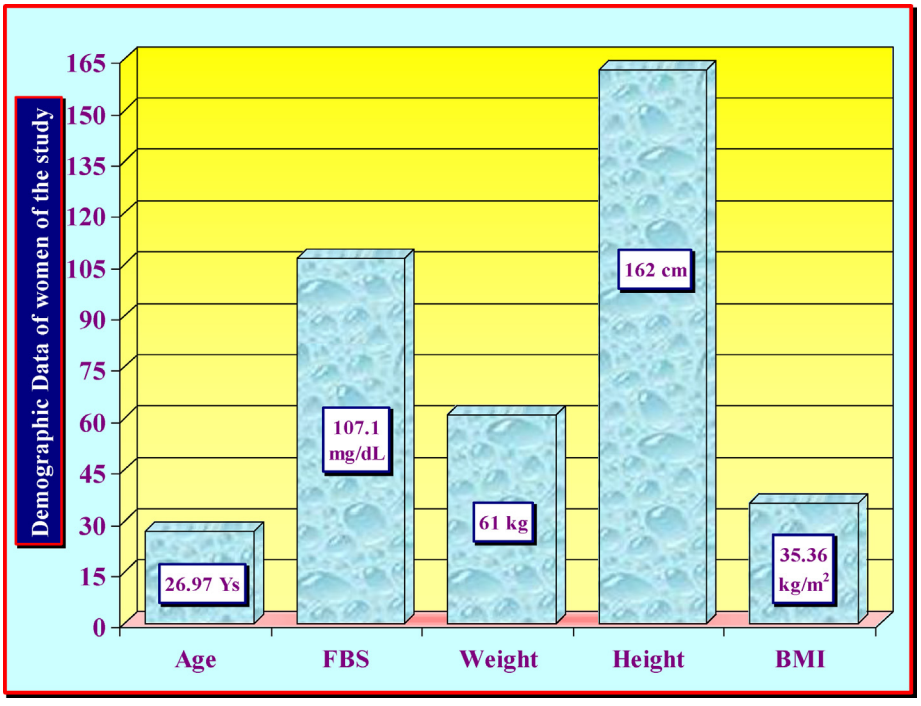

Fig. 1. Demographic data of women of the study.

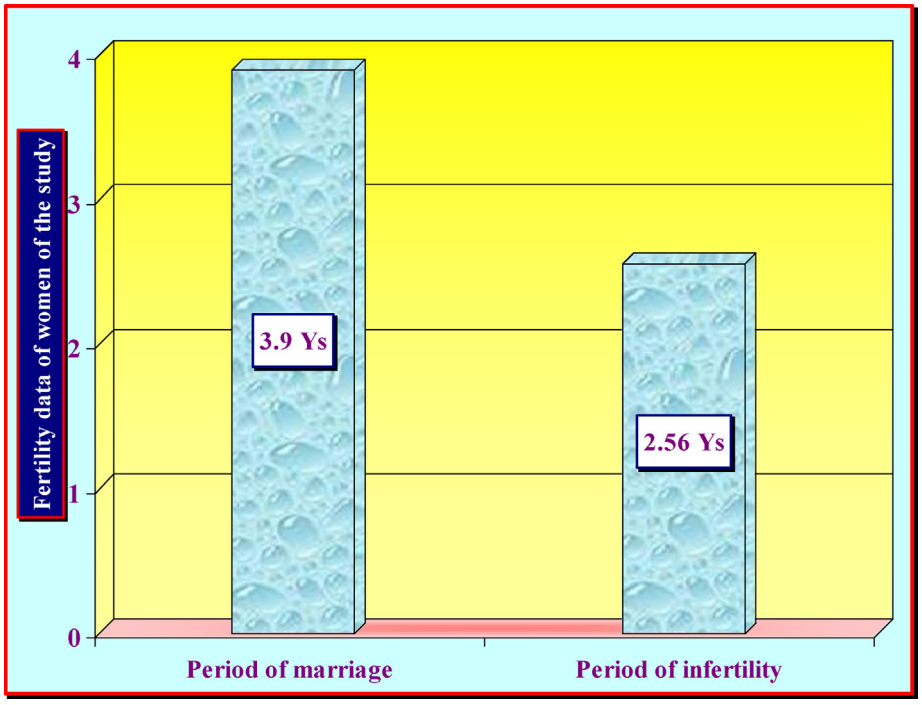

Fig. 2. Fertility data of women of the study.

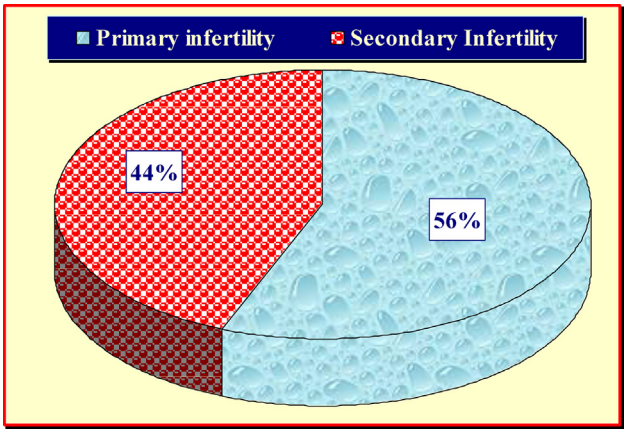

Fig. 3. Types of infertility in women of the study.

Table 3. Causes of infertility as diagnosed by transvaginal ultrasonography in patients of the study.

Causes	*n* (%)	*P* value
Free	12 (12)	0.021
Fibroid	22 (22)	
Endometrial polyp	5 (5)	
Hydrosalpinx	12 (12)	
Posy-append	6 (6)	
Post-CS	4 (4)	
Postovarian cystectomy	2 (2)	
Chocolate cyst	8 (8)	
Congenital anomaly	2 (2)	
Polycystic ovary	39 (39)	

prominent in our series of cases followed by fibroids ($P = 0.021$) (Fig. 4).

Table 4 shows that the serum level of FSH ranged between 3.25 and 9.07 mIU with a mean of 5.96 ± 1.63 mIU (Fig. 5). The serum level of LH ranged between 7.08 and 20.1 mIU with a mean of 13.03 ± 2.54 mIU (Table 4, Fig. 5). The LH/FSH ratio ranged between 1.68 and 4.1 with a mean of 2.26 ± 0.45. The serum level of free serum testosterone ranged between 0.8 and 8 Pg/ml with a mean of 3.51 ± 0.84 pg/ml (Table 4, Fig. 6). The serum level of prolactin ranged between 2.3 and 22.7 ng/ml with a mean of 11.45 ± 3.71 ng/ml (Table 4, Fig. 6). The serum level of progesterone ranged between 8.07 and 30.2 ng/ml with a mean of 14.5 ± 3.93 ng/ml (Table 4, Fig. 6). The serum level of estradiol ranged between 227 and 390 pg/ml with a mean of 308.9 ± 36.7 pg/ml.

4. Discussion

Infertility is defined as the inability to get pregnant after a year of unprotected intercourse. Approximately 15.5 % of women have infertility. The causes of infertility can involve tubal factors (14 %), ovulation defects (21 %), and male factors (26 %), and they are frequently left unexplained by conventional testing (28 %). Evaluation of the ovary reserves, tubal and uterine evaluation, thyroid issues, prolactin disorders, and semen parameters

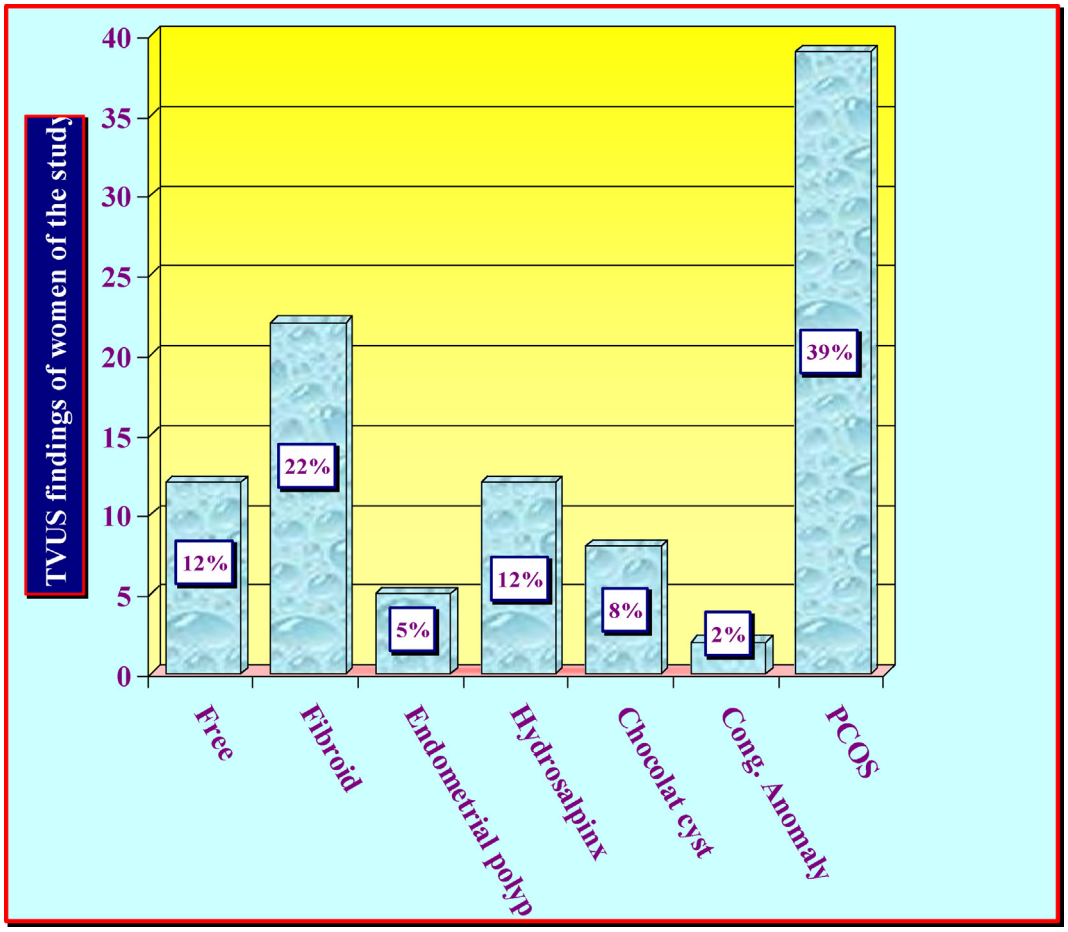

Fig. 4. TVUS findings in women of the study. TVUS, transvaginal ultrasonography.

are all part of the basic workup for infertility. The use of sonography in assessing and treating female infertility will be covered in this article.[8]

Unexplained infertility is commonly defined as the absence of a specific reason for a couple's inability to conceive following 12 months of trying to pregnant. The couples had standard infertility examinations, including ovulation, tubal patency, uterus cavity, and analysis of semen.[9]

In the modern examination of female infertility and the treatment of assisted pregnancy, ultrasound has taken on a crucial role. An understanding of basic reproductive physiology, the reasons for infertility, and how ultrasonography may help with the diagnosis and therapy of this condition are all prerequisites for doing a fertility scan, in addition to different skills from those needed for other gynecologic scan indications.[10]

Table 4. Laboratory investigations in patients of both groups.

Variables	Range	Mean ± SD
FSH level (mIU/l)	3.25–9.07	5.96 ± 1.63
LH level (mIU/l)	7.08–20.1	13.03 ± 2.54
LH/FSH ratio	1.68–4.1	2.26 ± 0.45
Free testosterone (pg/ml)	0.8–8	3.51 ± 0.84
Prolactin (ng/ml)	2.3–22.7	11.45 ± 3.71
Progesterone (ng/ml)	8.07–30.2	14.5 ± 3.93
Estradiol (pg/ml)	227–390	308.9 ± 36.7

FSH, follicle-stimulating hormone; LH, luteinizing hormone.

It is difficult to conceive reproductive medicine and the treatment of different artificial reproductive technology procedures without the tremendous amount of data and guidance offered through an ultrasound scanning. Ultrasonography provides vital details as well as a full anatomic view of the reproductive organs. The use of ultrasound to characterize follicles and reproductive treatments is widely established.[11]

The purpose of this research was to assess the role of TVUS in the assessment of uterine and adnexal infertility factors.

This study was conducted on 100 infertile women, who were selected from those attending the Outpatient Clinic at Sayed Galal Hospital, Al-Azhar University, and the Damanhour Medical National Institute's Obstetrics and Gynecology Department's outpatient clinics.

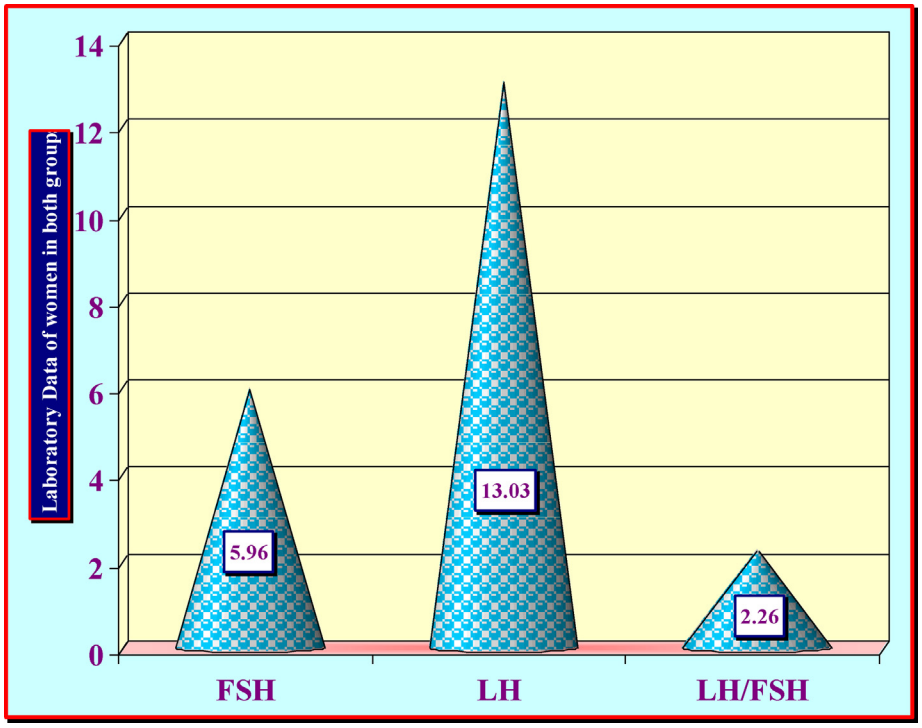

Fig. 5. Laboratory data of women in the study.

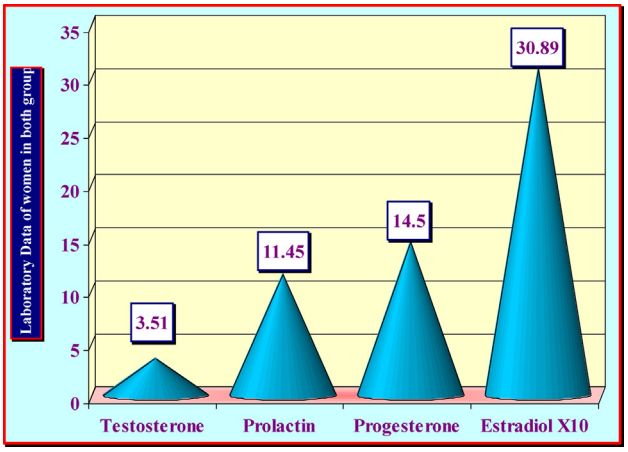

Fig. 6. Laboratory data of women in the study 'continued.'

Our results revealed that the age of women's included in the study was in the third to fourth decade of life and the mean was 26.97 ± 4.7 years.

In their study, El-Darwish et al.[9] found that the ages of the included ladies in the research were between the second and the fourth decade of life, which runs in line with our results.

El-Kerdawy et al.[12] revealed in their study that the age of women was between the second and fifth decade of life with a mean of 31.5 years, which conflicts with the results of our study.

Kant et al.[13] found in their study that the age of women included in the study was between the third and fifth decades of life with a mean of 31.85 ± 4.45 years, which was in agreement with our results.

Hussain and Das[14] found in their study that the average age of women involved in the research was 28 ± 6.7 years, which runs in line with our study.

In our study, the mean weight was 61 ± 8.3 kg and the mean height was 162 ± 5.8 cm, and the mean BMI was 35.36 ± 2.89 kg/m^2. The mean fasting blood sugar was 107.1 ± 22 mg/dl.

Hancock et al.[15] found in their study that BMI of the included women was 23.4 ± 4.6, which disagree with in the results of our study. Also, Hussain and Das[14] found in their study that the BMI was 24.5 ± 3.6, which conflicts with our results.

The mean marriage duration is 3.9 ± 1.12 years, with a mean period of infertility of 2.56 ± 1.051 years, and 56 % of them had primary infertility while 44 % had secondary infertility.

Kant et al.[13] revealed in their study that 57.33 % of cases had primary infertility, while 42.67 % had secondary infertility, which was in agreement with our results.

Hussain and Das[14] found in their study that primary infertility constitutes 75 % of cases, while secondary infertility constitutes 25 % of cases, which conflicts with what we found in our study.

In their study, Deshpande and Gupta found that primary infertility (57.5 %) is more common than secondary infertility (42.5 %). Female factors were

responsible for 46.6 % of instances, with polycystic ovarian syndrome becoming the major reason (46 %). According to our results, tubal factor infertility was linked to infectious reasons, including pelvic inflammatory illness and tuberculosis.[16]

The use of TVUS succeeds in the diagnosis of the infertility cause in 88 % of cases, while 12 % of cases were free during TVUS examination. During TVUS, 22 % of cases were detect with fibroids, 5 % with endometrial polyps, hydrosalpinx in 12 %, and chocolate cyst of endometriosis in 8 %, 39 % of cases had PCOD, while only 2 % of cases were detected with congenital anomaly as a cause of infertility by TVUS.

In their research, El-Kerdawy et al.,[12] revealed that the reasons for infertility were fibroid (13.3 %), endometrial polyps (23.3 %), hydrosalpinx (3.3 %), endometriosis (chocolate cysts) (10 %), and PCOD (23.3 %), which conflicted with what we found in our study except for chocolate cysts, which was in agreement with our result.

Wall et al.[8] concluded in their study that TVUS is beneficial in the diagnosis of PCOD in infertile women in more than or equal to 25 % of cases which runs in line with our results.

In line with our findings, Hussain and Das[14] discovered in their study that the TVS study results among 100 infertile patients revealed that 69 % of patient had PCO, 6 % had fibroids, 19 % had anatomical issues, 18 % had endometrial polyps, 12 % had endometriosis with chocolate cyst, and 2 % had intrauterine and septate uterus, which was in agreement with what we found in our results.

El-Darwish et al.[9] found in their study that vaginal ultrasonography detected abnormal findings in 93.3 % of cases, whereas 6.7 % cases were free while they found intrauterine adhesions in 30 % of cases, fibroid was found in 23.3 % of cases, intrauterine polyps in 20 % of cases, and septum was detected in 3.3 % of cases which run in lines with what we found in our study.

Ajossa and colleagues stated that both endometrial biopsy and TVUS showed relatively poor sensitivity but a high specificity for diagnosing endometrial polyps. The ability to detect polyps accurately may depend on the TVUS endometrial thickening's high sensitivity, which signifies the use of TVUS as it is noninvasive.

Apirakviriya and Rungruxsirivorn stated that three D-TVUS exhibited 84.1 % diagnostic accuracy in diagnosing uterine cavity anomalies in women who are infertile. There was pathology in the uterine cavity in a significant portion of individuals. Thus, hysteroscopy is advised for the precise diagnosis and detection of lesions of the uterine cavity, which was in conflict with our conclusion.[18]

Armar and colleagues stated that saline infusion sonohysterography (SIS) should be used as the first line diagnostic method in patients with subfertility as it is an easy-to-use but hugely beneficial method for examining benign uterine pathology and a viable modality for detecting tubal and uterine pathologies when compared with radiograph hysterosalpingography for patients with infertility, which runs in line with what we found.[19]

Also, Darzi and colleagues, stated that SIS is an extremely sensitive investigation technique and similar to the gold standard technique, hysteroscopy, in the diagnosis of intrauterine anomalies in subfertile women,for example, uterine polyps, submucous myomas, uterine abnormalities, and intrauterine adhesions. In agreement with our results, it may also be used to detect subfertile patients before they undergo IVF therapy.[20]

Abdel-Gadir[21] stated in his study that 3D-SIS when available may provide important information, particularly for mapping and recording the degree of intrauterine disease, which also runs in line with our results.

Athanasiadis et al.,[22] concluded in their study that 3D-US seems to be a highly accurate approach for detecting congenital uterine abnormalities such as arcuate uterus and septate uterus with short septum, which was in agreement with our findings.

Hormonal assay of cases of infertility in our study revealed that all hormonal profile values were within normal values as the FSH mean was 5.96 ± 1.63 mIU; LH was 13.03 ± 2.54 mIU; LH/FSH ratio was 2.26 ± 0.45; free testosterone was 3.51 ± 0.84 pg/ml; serum prolactin was 11.45 ± 3.71 ng/ml; serum progesterone was 14.5 ± 3.93 ng/ml; and serum estradiol was 308.9 ± 36.7 pg/ml.

4.1. Conclusion

From this study, we can conclude that TVUS examination is beneficial in the diagnosis of uterine and adnexal diseases that can cause infertility. So, we recommend its use in these purposes.

Conflicts of interest

There are no conflicts of interest.

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