Journal of Health, Medicine and Nursing
ISSN 2422-8419 An International Peer-reviewed Journal
Vol.49, 2018

Sonographic Evaluation of the Pelvic Causes of Female Infertility

Alyaa Raheem[1*] Luma Naji[1] Dr. Hawraa Emad[2]
1.Faculty of medical and health technology, Bab AL-Moadem, Baghdad ,Iraq
2.Gynaecology hospital, Karbolaa Health office, Karbolaa, Iraq.

Abstract
Introduction: Ultrasound imaging plays a major role in the diagnostic evaluation of infertile women. Several ultrasound procedures have been used as an investigation method for the pelvic causes of infertility. These causes are diverse, including tubal and peritoneal abnormalities, uterine and cervical factors, and ovarian disorders. In the majority of the cases, the imaging procedures begin with transabdominal ultrasound and this technique may compensate any further investigation.
The aim of this study is to consider the role of ultrasound in the detection of pelvic causes of infertility and to quantify the incidence of these causes for Iraqi women in comparison with the global norms.
Method: A quantitative methodology was used to analyse the collected data. This study was done retrospectively by reviewing the data during 12 months for all the infertile women who registered in 3 gynaecological hospitals in Iraq. About 750 infertile women from (15- 45) years old were investigated during this year. However, Only 255 cases were used according to the sample size calculator in order to deliver a 95% confidence level.
Result: Of the 255 cases, 53.33% were normal as diagnosed by ultrasound scan and only 119 patients recognised as abnormal patients. Ovarian factors were present in 35.69 % of the selected population and the most common finding was the PCO, which present in 88 patients. The second noticeable factor was the uterine factors presented in 9.8%. Other factors such as endometriosis and PID are presented in only 1.18% of the population.
Conclusion: Transabdominal ultrasound is a valuable modality to deliver maximum information around the infertility causes associated with female pelvic organs. The main detected cause was PCO presents in more than one third of population followed by uterine fibroid in about 10 % of the population.
Keywords: Transabdominal ultrasound; PCO; abnormalities; uterine fibroid.

1. Introduction

Infertility is one of the major public health problems. It can be defined as loss of the ability to achieve pregnancy after six to twelve months of unprotected intercourse (Denson, 2006, Carnegie, 2013). McLaren, (2012) identified that sterility can be divided into two main types; the primary infertility to describe a couple who can never achieve pregnancy, and the secondary infertility to represent a couple who has achieved one or more pregnancy in the past but cannot conceive at this time.

The causes of infertility are variable and factors such as physical problems, hormones, lifestyle and environment can contribute to a large extent in unproductivity. Most problems associated with female infertility are related to ovum production with premature ovarian failure as a common cause (Qiao, Yang and Li, 2012). This disorder results in the stoppage of the functions of the ovary before the onset of menopause. Polycystic Ovary Syndrome (PCOS) has also been identified as a major cause, playing an important role in the ovulation. It is a condition where the eggs may not be released regularly or could lead to unhealthy egg production (Horn and Geraci, 2013). Brugo-Olmedo, Chillik and Kopelman, (2002) reported that infertility may affect one in five or six couples in the reproductive age. In contrast, a recent study by Mascarenhas et al, (2012) found that infertility may affect one in every four couples, suggesting that the rate of infertility is increased. Each researcher has a specific reason for this rise, but there is no obvious cause. As a result of this elevation in infertility rate, the demand for an advanced and appropriate investigation has been increased. Pelvic ultrasound and Hysterosalpingography (HSG) are considered useful modalities in both detecting the aetiology of infertility and direction of the clinical management (Carnegie, 2013). However, selection of modality and investigation is determined by the organ of concern, and in specific cases, more than one diagnostic approach may be performed to provide the most complete assessment. Final diagnosis should provide the clinician with useful prognostic information regarding possible future treatment (Ekerhovd, Fried, and Granberg, 2004). The primary function of ultrasound is to identify the potential sources of female infertility. The secondary function is to treat some of these conditions or to direct the future management and treatment (Choussein and Vlahos, 2012).

1.1 Assessment of female infertility

The causes of female infertility can be categorised broadly based on anatomy, include uterine abnormalities, fallopian tubes, and ovaries. Patients with infertility may have emotional, psychological and financial pressure (Sadow and Sahni, 2014); therefore all these aspects should be taken into account during the evaluation of infertility. Several attempts have been made to detect the causes of infertility in women; (Derchi et al., 2001;

Brugo-Olmedo, Chillik and Kopelman, 2002; Ekerhovd, Fried and Granberg, 2004; Steinkeler et al., 2009; La Sala et al., 2011; Abrao, Muzii and Marana, 2013). A consistent finding is that the common causes of female infertility are uterine abnormality, endometriosis, ovulatory causes such as polycystic ovaries (PCO) and tubal-peritoneal infertility. Ultrasound helps in determining the presence or absence of most of the morphological changes in the female reproductive system (Darchi et al., 2001) and it is particularly effective in demonstration of global image of these structures in addition to the adnexal pathology. The technological development of ultrasound such as 3D, endovaginal, SHG, and colour Doppler ultrasound along with highest quality transabdominal procedures have increased the ability of ultrasound to detect most of the causes of infertility, (Saravelos, Cocksedge and Li, 2008).

1.2 Uterine factors

Several studies proved that uterine abnormalities are a relatively common cause of female infertility. Letterie, (2011) in his investigation of congenital uterine anomalies labelled that the reproductive loss rates for all uterine abnormalities range from 21% to 50%. Also, Niknejadi et al, (2012) demonstrated that Müllerian fusion defects are the most common types of congenital anomalies which disturb the reproductive system. These types of anomalies may occur during the steps of the Müllerian developmental process (Saravelos, Cocksedge and Li, 2008; Wold, Pham, and Arici, 2006). The American Society of Reproductive Medicine developed a specific classification of the uterine malformation according to the degree of failure of the development of the Müllerian duct. This classification is widely accepted and used globally. The key aspects of these abnormalities listed as follows.

(1) Müllerian hypoplasia, which may include the vagina, cervix, fundus, tubes, or their combination.
(2) Unicornuate uterus hypoplasia involving one of the two Müllerian ducts. This is further subdivided according to the presence or absence of the rudimentary horn.
(3) Didelphys uterus (failure of lateral fusion of the vagina and uterus Müllerian ducts).
(4) Bicornuate uterus (incomplete fusion of the uterine horns at the level of the fundus), which may be partial or complete.
(5) Septate uterus (absence or incomplete resorption of the uterovaginal septum), either complete or partial.
(6) Arcuate uterus (a mild indentation at the level of the fundus).
(7) Diethylstilbestrol (DES) exposed uterus (T-shaped uterus, resulting from DES exposure of the patient in utero).

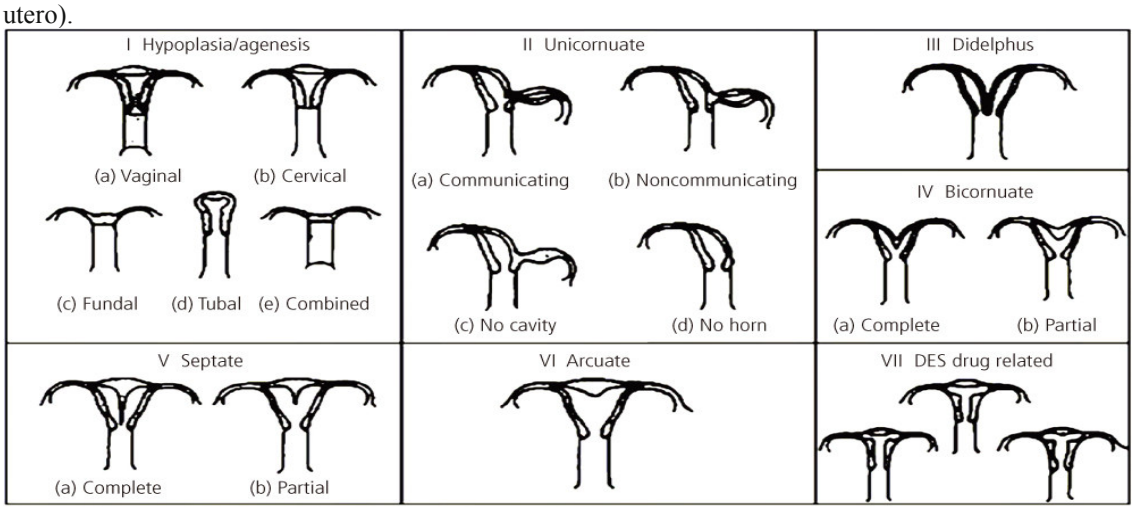

Figure 1: Classification of uterine malformation. Source: American Society of Reproductive Medicine (Lee and Ku, 2011).

Despite this, there is no specific procedure or criteria for the diagnosis of each anomaly and the result will depend on the clinician's impression (Woelfer et al., 2001). This classification excludes some anomalies such as cervical atresia, vaginal anastomosis and vaginal septum (Pavone et al., 2006), which may be described according to the component. The diagnosis and treatment methods rely on the types of malformation.

Repair of these Müllerian anomalies by caesarean section may be accomplished through surgery and may result in uterine synechiae or uterine atresis. This is defined as the presence of intrauterine adhesions (IUAs) or a combination of fibrotic tissue. It may be partial or complete; which indicates serious and severe adhesions resulting in menstrual dysfunction and infertility (Ahmadi and Javam 2014).

1.3 Tubal-peritoneal factors

Coussein and Vlahos, (2012) in their evaluation study found that 25–35 % of female infertility is caused by

tubal-peritoneal pathology. This condition may occur as a result of ectopic pregnancy, Pelvic inflammatory diseases (PID), endometriosis, and pelvic or adnexal adhesions. These factors may be revealed by pathology, but may not be adequately specified in terms of diagnosis (Patrellits et al., 2013). Brugo-Olmedo Chillik and Kopelman, (2002) in their review discussed that, any anatomical or physiological changes to the tubes may be associated with infertility since the outer end or ampullar section is responsible for fertilisation and the fallopian tubes are responsible for oocyte uptake. For example, the contraceptives are hypothesised to have a direct effect on fertility. Also numerous studies have attempted to explain the link between peritoneal diseases and infertility. For instance, a trial undertaken by Koch et al, (2012) defined endometriosis as the presence of endometrial tissue stroma or glands outside of the uterine cavity. It is capable of causing a chronic inflammatory reaction, which is considered one of the causes of infertility. This condition may affect 5-15% of women in their reproductive period. Bulletti et al, (2010) emphasised that there is a correlation between endometriosis and approximately 48% of infertile patients developed endometriosis compared with 5% of normal fertile patients. 30-50% of the patients with endometriosis suffer from reproductive failure. There are, however, indications that the prevalence of infertility in females with endometriosis is linked to variable factors such as, anatomical disorders, anovulation and changing of the luteal phase (Abrao, 2013). This implies that uterine implantation may be affected by endometriosis.

1.4 Ovarian factors

Ovarian disorders are found in approximately 15% of all infertile cases and more than 40% of unproductive females as presented by Saravelos, Cocksedge and Li (2008). An obvious symptom of this disorder is the disturbance of the menstrual cycle. However, it may also be more subtle. Accurate diagnosis is a critical step in the treatment process since there are specific treatments for different types of disorders (PCASRM 2012). Horn and Geraci, (2013) identified that polycystic ovarian syndrome (PCOS), obesity, weight loss, hyperprolactinemia, thyroid dysfunction, and arduous exercise, are the most common causes of ovarian disorders. The conception cycle begins in the pre ovulatory follicle, which should measure 18mm or more. Irregular cycles are caused by insufficient luteal which may be as a result of the failure of follicle to rupture, empty follicle or follicular retention. This idea was supported by Healy et al, (1994) and Jain, Sinha and Shukla, (2004). However, Catteau-Jonard et al, (2012) examined 95 patients and demonstrated that, it is possible for normal females with regular menstrual cycles to have PCO and a consequently low rate of fertilisation. They found that the PCOS detected in 21-63% of the women were actually normal in their study. In this study of ovulation disorder, patients provide a history of oligomenorrhea or amenorrhea, which is eventually considered as causes of infertility due to ovulatory dysfunction. Research suggests that this disorder may be linked to the hypothalamic pituitary or be due to the disorder of the ovary itself. Correspondingly, Harris et al, (2013) showed that conditions such as ovarian tumour, ovarian failure and Turner's syndrome may prevent the pregnancy by changing ovarian responses to the hormonal signalling, which may give rise to infrequent ovulation. In the same area Broekmans, (2009) in his study of ovarian ageing, opines that a lower level of ovarian reserve, infertility and early menopause may occur as a result of loss of oocytes before maturity and the diminishing of the quality of oocytes thought to be related to the elevation of meiotic non-disjunction, which is associated with women's age. This diminution of follicle quality may reduce the possibility of fertilisation and subsequent pregnancy. Ovarian reserve refers to the follicle present in the ovary at any given time. This decline of the follicle refers to both the quality and quantity of the available follicle in the ovaries. Therefore, ovarian ageing should always be considered as a differential diagnosis for ovarian disorders in infertile women. In many cases the decline will be in the size of the follicle as in PCOS. Recent studies have shown that the pathophysiology of PCOS is caused by several factors which include hyperandrogenemia, hyperinsulinemia, obesity, and elevated steady-state LH levels. Nonetheless, the exact regulatory process is still under investigation (Harris et al, 2013).

1.5 Other factors

There are several factors that should be considered during the assessment of infertility, especially when it concerns unexplained infertility; the first factor is the age of woman under investigation. Maheshwari, Hamilton, and Bhattacharya, (2008) demonstrated that infertility rates have been increasing gradually with age for both men and women, but it is more pronounced in women above 40 years old, where the chances of pregnancy decline to only about 5% per month with a spontaneous miscarriage rate of 34% to 52% (Denson, 2006). Implantation failure is the second factor affecting conception in women. Earlier research indicates that this type of infertility may be caused by insufficient secretion of progesterone, which may cause non-respective endometrium for the nidation of the blastocyst. Then this may have negative effects on the pregnancy (Healy et al, 1994). Denson, (2006) supported the previous study and he listed the main crucial factors that may have an adverse effect on pregnancy. He identified that, recurrent miscarriage can be considered the third factor that has been linked to infertility. It is estimated that there is one third of women with recurrent abortions may actually be infertile. However, the evidence supporting this assertion is weak since two thirds of the women are able to

achieve pregnancy and carry it to full term. Another aspect may impact fertility is lifestyle, which includes nutrition, sports, clothing, alcohol drinking, tobacco and drugs. The last factors are psychological and occupational stress; some authors have established a link between stress, anxiety and depression with infertility. However, the exact role these factors play is fairly uncertain. Occupation involving exposure to textile dyes, lead, and cadmium is strongly associated with a couple's infertility. This is common in women with unexplained infertility.

An evaluation of the infertile female has increasingly become more detailed as a result of high technological development; however, the appropriate evaluation is based on an understanding of the physiology of the normal female reproductive system (Zahalsky and Nagler, 2001). To provide an optimal investigation protocol for infertility, the diagnosis should be more accurate, expeditious, cost-effective, reliable and as minimally invasive as possible. Furthermore, the final diagnosis should provide the clinician with useful prognostic information regarding possible future treatment (Ekerhovd, Fried, and Granberg, 2004). This study takes all these aspects into account to evaluate the role of ultrasound in the diagnosis of female pelvic causes of infertility.

2. Methodology

A primary study approach was used in the form of a health service evaluation. Quantitative study have been used to predict reliable outcomes for the same event in the future. Furthermore, it is more specific with data presented in numerical and statistical form and it can provide descriptive data that facilitates capturing a picture of a user population. The data compared to other populations defined by WHO statistics. This study was performed retrospectively by reviewing the data during a 12 month period for all the infertile women registered in 3 gynaecological hospitals and 5 private clinics in Iraq. The study design has a number of attractive features as the data can be quickly gleaned from existing records to answer the research question. It is a less expensive and time saving method; furthermore, it enables the researcher to focus on the study question, modify the hypothesis, determine an appropriate sample size, and identify practicability issues for future prospective research (Hess, 2004).

2.1 Sample size and population

The data were collected from three gynaecological hospitals and five private clinics in Iraq between September 2013 and September 2014; during this period about 750 infertile women were investigated. Patients were healthy infertile women from 15– 45 years old, presenting with either primary or secondary infertility of more than 12 months. In order to achieve more precise estimates of this population, the sample size calculator was used and it showed that the sample should be 255 cases in order to deliver a 95% confidence level. A random sample of patients with infertility was collected producing unbiased estimates of the total population. The data was saved in boxes with 50 files in each box. 20 files from each box have been selected randomly, and then these files reviewed to identify how much information a sample can deliver about the population. The document which not includes the entire requirement was excluded. After that, the selected patients were divided into categories according to the age groups and different types of pelvic causes of infertility as labelled in table 1. The exclusion criteria were all the infertile females with low partner sperm activity because it was a policy of the infertility department in the hospitals. The second excluded patients, if they have only one ultrasound which was detected by one sonographer as this may limit the reliability of the result. The final exclusions were the women with more than 45 years old as most causes may relate to post-menopausal issues.

Table 1. The distribution of the infertility causes and types according to patient's age.

Patient age	**Type of infertility Number of patients**		**Normal**	**Uterine factors**	**Ovarian factors**	**Others**
	Primary	Secondary				
< 20	37	3	21	4	15	0
21-30	50	34	40	5	37	2
31-40	38	58	58	7	30	1
40>	23	12	17	7	11	0

The information depended on the clinical examination and ultrasound reports, which are available in the file for each infertile patient. The clinical examination was conducted by the gynaecologist, who recorded general information about the patient, such as patient age, type of infertility (primary or secondary) and the hormonal results before sending the patient to an ultrasound examination. Then, a transabdominal ultrasound was requested on the 13th day of cycle if the patient's hormonal results appeared normal in the laboratory test.

2.2 ultrasound procedure

A high spectral resolution ultrasound was used to scan the patients. All the work for the diagnosis was carried

out with a Philips HD 11 XE / Italian ultrasound using the 2D, V8-4 Volume curved array transducer (4-8 MHz extended operating frequency range) (Philips, 2008), which can provide high resolution for looking at the actual structural volume with an 85 degree field-of-view. It was possible to identify the uterus, ovaries and adnexal structures. All patients underwent two ultrasound examinations in the follicular phase (day 13 of the cycle). All sonographic investigations were accomplished by an expert radiologist with more than 5 years' experience; the scans were performed at different periods with at least one month between the reports to achieve intra-rater reliability. A transabdominal ultrasound was performed through the full extended bladder to be used as a window for clear visualisation of the pelvic organs. The uterus, ovaries and other pelvic structures were inspected in sagittal and transverse procedures. Any uterine abnormalities such as, endometrial thickness, echo pattern, adnexal abnormalities, pouch of Douglas, and ovarian distortion were scrutinised. The size of the uterus and both ovaries were calculated and recorded; also the follicle size was measured to identify if the patient had normal mature follicular to be recorded as normal patients if they do not have any other obvious cause. The transverse plane offered the best view with two dimensional images, which enabled the examiner to detect most congenital anomalies of the uterus. In transvaginal ultrasound a thin transducer is covered with the conducting gel and inserted into the vagina. This procedure is performed to avoid the intervening gas-filled bowel that may interact with the transmission echo and obscure some of the pelvic details in transabdominal ultrasound. The form of the protocol performed according to the indication of the requesting ultrasound. Only one method may provide enough information, or in some cases, both methods were used to provide further details for the diagnosis or treatment. In the undertaken paper, the radiologist was not blind to the previous ultrasonography or any other medical history.

2.3 Ethics

Proper authority of research is crucial to ensure that the community can benefit from research in health and social care. Good governance must ensure that the dignity, human rights and safety of contributors are the major considerations of a health study. The study should be properly sustained, managed and approved. This research followed local governance to obtain approval from the local health office, which provided consent to collect the data from the hospitals after taking the agreement from the scientific committee. This committee has a responsibility to ensure that research conducted at health and social care in their country and offers the likelihood of real benefits either for the patients, or to those who subsequently use the services, or both. The main approval was obtained from the committee and the hospitals managers, who were seriously interested in approving research studies using the data available in the infertility and ultrasound departments for developing a specific statistical study. Patient agreement was not required for this research since the study was carried retrospectively depending on archived data. The researcher was responsible for using anonymized data to protect patient information.

3. Results

The data presented below referred to the distribution of the main causes of infertility as depicted by 2D ultrasound.

3.1 Statistical analysis

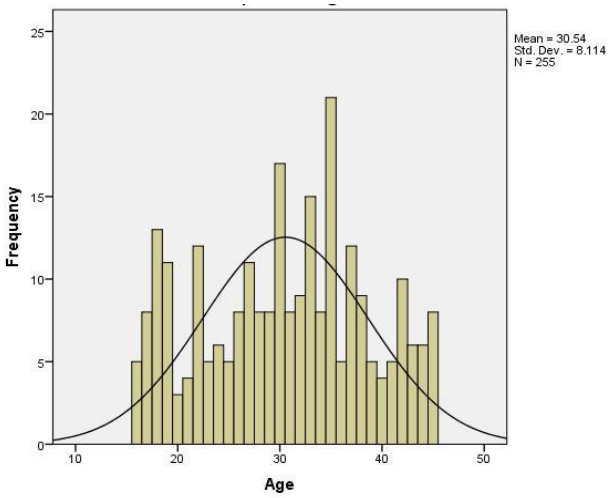

Figure 2. The correlation between the frequency of infertile women and their age

Figure 2 represents the empirical distribution of infertility in the given population. It is apparent that the patients started their registration as infertile women as early as 16 years of age, with very few infertility rates

recorded with a frequency of less than 5. A gradual increase in the infertility rate was observed in women between 16 and 30 years with a mean age of approximately 30 years; thereafter, the distribution dropped steadily until the age of 45. The standard division was intended for this distribution and it was 8.114, which means that the data was not more spread out of the mean.

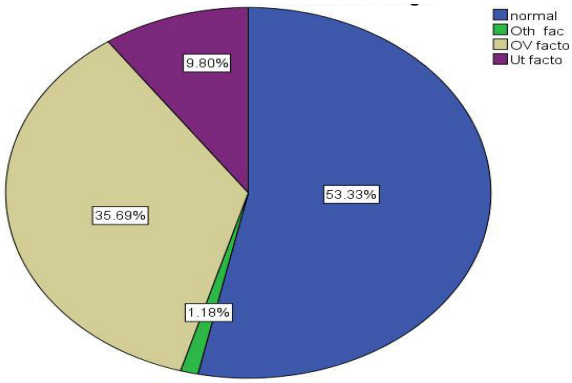

Figure 3. Main infertility factors by 2D ultrasound.

The graph above represents the results from 2D ultrasound findings, according to the infertility factors. The single most striking observation was the ovarian factors which presented with more than one third of the examined patients (35.69%). Ovarian factors in this context referred to pathologies or anomalies, such as, PCOS, ovarian mass, and congenital small size ovaries. The next prevalence is the uterine factor accounting for 9.8% of the selected population, which may include uterine fibroid, bicournuate uterus, septate uterus, thin endometrium, and congenital small size uterus. The less common factors presented in only 1.18% of the population are referred to as other factors which could indicate any pelvic abnormalities (such as endometriosis, PID, and adnexal mass).

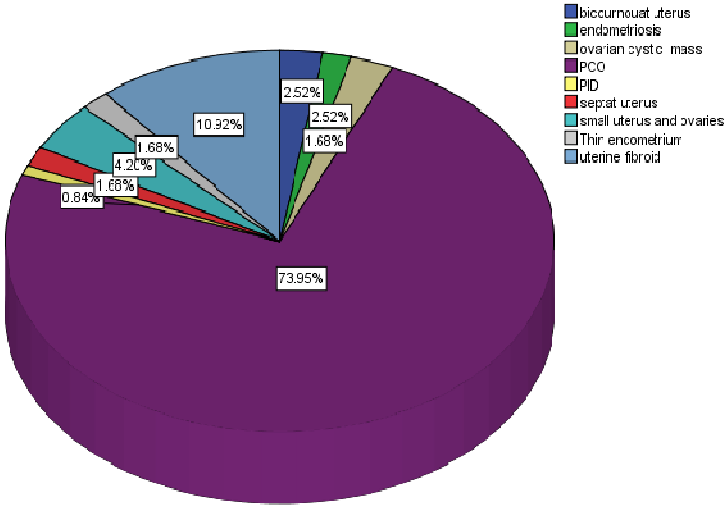

Figure 4. Pelvic abnormalities as detected by ultrasound.

The graph above purely represents the percentage for each variable as detected by ultrasound in the given population. All the normal patients are excluded. The most striking finding of the data is that, PCO demonstrated in the majority of the population with approximately (74%) of the 119 patients who presented with abnormal findings. Other factors represented in about (26 %), which is subdivided into; uterine fibroid with a presentation of (10.92%) of the patients. Bicournuate and ovarian cystic mass have been presented in (2.52%), whereas endometriosis, thin endometrium and septate uterus, all are found in the same percentage of (1.68%), with only 2 cases for each variable. A congenital small uterus and ovaries were seen in 4.20% of the abnormal population. The minority of the patients had PID which was identified in one patient with a percentage of (0.84%).

Two scans with two observers used to enhance the validity of the test, a statistic takes into account the fact that observers will occasionally agree or disagree simply by chance, should be included; for this purpose a kappa coefficient was used as shown in tables 2 and 3 below. A kappa coefficient can deliver more statistical information than a simple design of the raw section of the agreement. It is evidenced that a kappa of 1 designates perfect agreement, while a kappa of 0 points represents an agreement by chance with a commonly cited scale for kappa interpretation value of 0.81–0.99, which is considered as almost perfect agreement (Viera and Garrett. 2005). The kappa value of this study was found to be 0.865 indicating a high level of agreement as presented in table 2 based on the given scale.

Table 2. Kappa statistic shows the Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of agreement Kappa	.0.865	.031	13.889	.000
N of Valid Cases	255			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Table3. Scan1 and Scan 2 Cross tabulation.

		Scan2		
		0	1	Total
Scan1	0	134	2	136
	1	15	104	119
Total		149	106	255

Table 3 demonstrates in quantitative measure the difference between scan 1 and scan 2 where the number 0 referred to the cases which were diagnosed as normal cases, whereas number 1 refers to the patients who have specific finding in both scans. It can be clearly seen that the first scan demonstrated 134 normal cases with total agreement to the second ultrasound; however, there were15 extra cases identified as normal in the second scan. On the other hand, only 2 patients appeared normal in the first scan and they demonstrated abnormal findings in the second examination.

4. Discussion

Ultrasonography investigation of infertility has been developed to provide clear details about most structures of female reproductive system and to be as accurate and effective as the traditional substitutes. This study, therefore, sought to document what is currently known about this condition and what could possibly be done to achieve better results in its management. The results of this study indicate that transabdominal ultrasound has shown an ability to identify most of the uterine, ovarian and adnexal abnormalities. However, the results cannot be clearly used for a final diagnosis since some of the subtle abnormalities cannot be detected by transabdominal 2D ultrasound (Gill, 2014). Despite the few types of congenital abnormalities identified by the current procedure, the results can be compared to the findings of previous work; for example, Lankford et al, (2013) reported that the incident can be 3-4% in the normal population, whereas Chan et al, (2011) stated that the incidence varied from 0.06% and 38% and this extensive variation is related to the assessment of different patient populations and the use of different diagnostic procedures. Furthermore, it can be compared with the results of the review by Saravelos, Cocksedge, and Li, (2008) who have labelled the incidence of congenital abnormalities, which can be detected via several procedures such as, HSG, SHG, TVS and laparoscopy, keeping in mind that the varying presentation of the patients and their different background/origin may have had an effect on the homogeneity of the results. They divided the incidence according to the geographic distribution. The percentage was (5.0, 4.8, 13.8, 28.6, 16, 20) % in Turkey, UK, Brazil, Spain, Serbia, USA respectively. On the other hand, Letterie, (2011) detected that congenital uterine malformations are variable in frequency and the incidence depends on the detection rates and clinical indications. However, the review by Chan et al, (2011) identified that the prevalence of congenital malformation in infertile women is approximately 8.0% at 95% CI, which is nearly similar to the result of this research. They identified that the overall prevalence in the infertile group was similar to the general population; for this reason it cannot be clearly estimated that there is a causal relation between uterine anomalies and infertility. However, in this review the method that they used to investigate the patients was not considered and the limitation of their results was that they included both high and low quality articles.

Similarly, Brugo-Olmedo, Chillik and Kopelman, (2002) identified that there is a wide spectrum of uterine abnormalities, whether congenital or acquired, which have a correlation with the presence of infertility. Whilst such a link is certainly true, these situations may also occur simultaneously during the evaluation of normal patients, hence leading to difficulty in founding a cause and effect relationship. This is probably due to the absence of information on the frequency of incidence of these findings in sterile patients.

Ovarian factors were the major causal finding of this research. It is presented in about 35.7% of the infertile women, which can be compared with previous studies by Pfeifer, (1995) and Saravelos, Cocksedge and Li, (2008) who demonstrated that ovarian disorders account for 40% of infertility conditions. Generally, what is unexpected is that most of the cases presented with PCO (34.5%) of the selected women. This is predominantly higher than many of the previous results. For example, a review by Harris- Glocker, and McLaren, (2013) has shown that PCO is a significant contribution to female sterility due to ovulatory dysfunction and it is estimated to affect 6–8% of reproductive-aged women. The prevalence of PCO was 2.2% to 26% in a study by Tehrani et

al, (2011). However, all these articles measured the incidence in the normal population. In contrast, studies estimating the incidence in the infertile population found that the percentage is much higher which seems to be in agreement with the result of this study even though they used different diagnostic procedure: for example, Haq, Aftab and Rizvi, (2007) identified that the rates of PCO in infertile women examined in infertility centres in Britain and United States were 20–25%, whereas a study by Hussein and Alalaf, (2013) reported the incidence of PCO in women attending the infertility centre in the north of Iraq to be 33% and they showed that the prevalence could reach 40% in women with infertility. This may be affected by demographic, ethnic distribution, biochemical features of PCO and the diagnostic procedure where both of these studies used TV ultrasound. The largest group (64%) of them was recorded as primary infertility. These results were comparable to Tehrani et al, (2011) who identified that the majority of the patients had primary infertility. Hussein and Alalaf, (2013) evidenced that 61.3% of women with PCO had a primary infertility with no significance difference in the mean age. In the current study the main age was about 30 years, which approximately similar to the previous study with the majority of incidence seen in the age group of 25–35 years.

The second common finding was intrauterine fibroid, presented in 13 patients, 10 of them had intramural fibroid and the remaining presented with subserosal fibroid. Contrarily, studies by Brugo-Olmedo, Chillik and Kopelman, (2002), Choussein, and Vlahos, (2012) and Niknejadi et al., (2012) evidenced that intrauterine fibroma or uterine fibroid was not a major cause of infertility. In the undertaken study, all patients who had intrauterine fibroid presented with primary infertility giving an impression that this condition should be given more attention in the investigation of infertility causes. It can be clearly seen that the incidence of uterine fibroid tumors increased gradually as women grow older. In accordance with the present results, the review by Evans and Brunsell, (2007) used ultrasound to identify the prevalence of the uterine fibroid in the normal population and they demonstrated that it varies from 4% in women from 20 to 30 years of age, to 11–18% in women from 30 to 40 years and 33 percent in women from 40 to 60 years of age. The incidence could depend on the population studied and the diagnostic method used. In the current study, uterine fibroid presented in 5% of 255 infertile women or (10.92%) from the 119 patients who have ultrasound findings after excluding the normal patients. Numerous studies have attempted to explain the role of uterine fibroid in infertility. However, the correlation is still not clear. Current evidence proposes that submucosal and intramural fibroid tumors, which interfere with the uterine cavity, can cause damage to fertilization (Rackow and Arici, 2007). The influence of intramural and subserosal fibroid tumors, which have no direct effect on the intrauterine cavity, is still uncertain. In spite of the lack of clear evidence of their role in fertility problems, patients with fibroids larger than 5 cm, multiple fibroid, submucosal uterine fibroid and intramural fibroid tumors which distort the uterine cavity are often regarded and treated as a patient with unexplained infertility (Bajekal and LI, 2000).

Another ultrasound finding was the endometriosis. A strong relationship between endometriosis and infertility had been reported in the previous studies. The data suggested that, endometriosis may have an unfavourable effect on productivity. A higher incidence has been recorded in infertile women and it is estimated that 30 to 71% of infertile women have endometriosis and the prevalence in asymptomatic women varies from 2 to 20%, and it ranges from 15 to 45% in women with pelvic pain (Halis and Arici, 2004). Carbognin et al, (2004) showed that the overall incidence was 5% to 10%. However, this prevalence depends on the diagnostic criteria. The precise occurrence of the disease is difficult to establish because the definitive diagnosis required further investigation such as laparoscopy or surgery. In this study the incidence was only 2.52%.

This research also did not find a significant incidence of the other possible causes of infertility. Very few other abnormal cases were noticed, such as thin endometrium, PID, and ovarian mass, whereas PID may present in more than half of the patients who have tubo-peritoneal infertility factors as demonstrated by Patrelli et al, (2013). A possible explanation for this low result in this study may be due to the low sample size or the investigation procedure.

5. Conclusion

Ultrasound is the most widely available and easiest way to perform practically as an initial diagnostic procedure of female infertility. Furthermore, it can increase accuracy and serve as a valuable screening tool if used in conjunction with TV sonography and SHG. The present study was designed to determine the incidence of female pelvic causes of infertility and compare the incidence with global norms. The result suggests that ovarian factors are the major ultrasound finding. The incidence was (35.69%). The highest percentage was PCO which represent approximately 74% of the ultrasound finding. Ovarian cystic masses are observed in 1.68%. Furthermore, the present study provided additional evidence with respect to the previous research regarding the incidence of uterine factor such (fibroid tumor, small uterus, bicornuate, septate, and thin endometrium) presented in about (10.9, 4.2, 2.5, 1.68, 1,68) % respectively.

Other infertility factors are present in very low percentages about 1.2% which are distributed between endometriosis and PID. Endometriosis was detected in 2.5% of the ultrasound finding while the lowest finding went to PID with less than 1% of the cases bearing in mind that not all the findings could be considered as the

direct causes of infertility, unless other diagnostic methods used in the investigation of the problem rule out other causes.

5.1 Implications for further research

It is recommended that further research be undertaken in the following areas; Investigation of the female pelvic organs in infertile women, depending on the developed technology of the US which shows more accuracy than 2D ultrasound with high sensitivity and specificity and has the potential to be used as a gold standard for identification and differentiation of uterine and ovarian abnormalities. Future training can also be performed prospectively instead of retrospective design and the population being investigated should also be critically considered, either infertile women or both men and women and the diagnostic test used can be done in more than one procedure: for example they can follow up the patient by combined TV ultrasound with SHG, 3D and colour Doppler ultrasonography.

This study records a high incidence of PCO among infertile women, which is in agreement with the previous study by Hussein and Alalaf, (2013) in the north of the same country. Consequently, more work will be needed to determine, the causes of this high prevalence and the way forward for better investigation and management to reduce this incidence.

Reference

1. ABRAO, M.S., MUZII, L. & MARANA, R. (2013). Anatomical causes of female infertility and their management. *International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics*, **123** (2), pp. 18–24.[Online]. Available at: http://www.ncbi.nlm.nih.gov/pubmed/24119894.
2. AHMADI, F. & JAVAM, M. (2014). Role of 3D sonohysterography in the investigation of uterine synechiae/asherman's syndrome: Pictorial assay. *Journal of medical imaging and radiation oncology,* **58**(2), pp.199–202. [Online]. Available at: http://onlinelibrary.wiley.com/doi/10.1111/1754-9485.12137/full.
3. BAJEKAL, N. & LI, T.C. (2000). Fibroids, infertility and pregnancy wastage. Human reproduction update, **6(6),** pp. 614.
4. BROEKMANS FJ, SOULES MR, FAUSER BC. (2009). Ovarian aging: mechanisms and clinical consequences. *Endocrine reviews*, **30** (5), 465-493. [Online]. Available at: http://press.endocrine.org/doi/abs/10.1210/er.2009-0006.
5. BRUGO-OLMEDO, S., CHILLIK, C. & KOPELMAN, S. (2002). Review Definition and causes of infertility. *Reproductive BioMedicine,* 2 (1), pp.173–185. [Online]. Available at: http://dx.doi.org/10.1016/S1472-6483(10)62193-1
6. BULLETTI, C, et al (2010). Endometriosis and infertility. *Journal of assisted reproduction and genetics*, **27** (8), pp.441–7.[Online]. Available at: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2941592&tool=pmcentrez&rendertype=abstract. [Accessed September 23, 2014].
7. CARBOGNIN, G., et al. (2004). Pelvic endometriosis: US and MRI features. *Abdominal imaging*, **29** (5), pp.609–18. [Online]. Available at: http://www.ncbi.nlm.nih.gov/pubmed/15162229.
8. CARNEGIE, D. (2013). Evaluation of Infertile Female Patients. Textbk of in Vitro Fertilization, 335. [Online]. Available at: http://books.google.co.uk.
9. CATTEAU-JONARD, S, et al. (2012). Polycystic ovaries at ultrasound: normal variant or silent polycystic ovary syndrome? *Ultrasound in obstetrics & gynecology : the official journal of the International Society of Ultrasound in Obstetrics and Gynecology*, **40** (2), pp.223–9. [Online]. Available at: http://www.ncbi.nlm.nih.gov/pubmed/22648908
10. CHAN, Y.Y. et al., 2011. The prevalence of congenital uterine anomalies in unselected and high-risk populations: a systematic review. *Human reproduction update*, 17(6), pp.761–71. Available at:http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3191936&tool=pmcentrez&rendertype=abstract.
11. CHOUSSEIN, S. & VLAHOS, N.F. (2012). Female Fertility Assessment. *Current Obstetrics and Gynecology Reports*, **1** (4), pp.174–181. [Online]. Available at: http://link.springer.com/10.1007/s13669-012-0022-7.
12. DENSON, V. (2006). Diagnosis and Management of Infertility. The *Journal for Nurse Practitioners* - JNP, **2** (6), pp 380-386. [Online]. Available at: http://www.npjournal.org/article/S1555-4155(06)00247-9/abstract.
13. DERCHI, L.E, et al. (2001). Ultrasound in gynaecology. *European radiology*, **11** (11), pp. 2137–55. [Online] Available at: http://www.ncbi.nlm.nih.gov/pubmed/11702153.
14. EKERHOVD, E., FRIED, G. & GRANBERG, S. (2004). An ultrasound-based approach to the assessment of infertility, including the evaluation of tubal patency. *Best Practice & Research Clinical ...*, **18** (1), pp.13–28. [Online]. Available at:http://www.sciencedirect.com /science/article/pii/ S1521693403001366.

15. EVANS, P. & BRUNSELL, S., (2007). Uterine fibroid tumors: diagnosis and treatment. *Am Fam Physician*. Available at: http://www.monografias.com/trabajos-pdf/uterine-tumors-diagnosis-treatment/uterine-tumors-diagnosis-treatment.
16. HALIS, G. & ARICI, A. (2004). Endometriosis and inflammation in infertility. *Annals of the New York Academy of Sciences*, **1034** (1), pp. 300–15.[Online]. Available at: http://www.ncbi.nlm.nih.gov/pubmed/15731321.
17. HAQ, F., AFTAB, O. & RIZVI, J., (2007). Clinical, biochemical and ultrasonographic features of infertile women with polycystic ovarian syndrome. *J Coll Physicians Surg Pak*, 17 (2), pp. 76–80. [Online]. Available at: http://jcpsp.pk/archive/2007/Feb2007/article4.pdf. [Accessed December 19, 2014].
18. HARRIS‐GLOCKER, M. & MCLAREN, J. (2013). Role of female pelvic anatomy in infertility. *Clinical Anatomy*, **96** (October 2012), pp. 89–96. [Online]. Available at: http://onlinelibrary.wiley.com/doi/10.1002/ca.22188/full.
19. HEALY, D. L., TROUNSON, A. O. And ANDERSEN, A. N. (1994). Female infertility: causes and treatment. *Lancet*, **343** (8912), pp. 1539–44. [Online] Available at: http://www.ncbi.nlm.nih.gov/pubmed/7914278.
20. HESS, D. (2004). Retrospective studies and chart reviews. *Respiratory care*, pp.1171–1174. [Online]. Available at: http://rc.rcjournal.com/content/49/10/1171.short.
21. HORN, M. & GERACI, S.A. (2013). Polycystic ovary syndrome in adolescents: *(women's health series)*. *South Med J*; 106: 570–576. [Online].
22. HUSSEIN, B. & ALALAF, S., (2013). Characteristics of polycystic ovarian syndrome in a sample of infertile Kurdish women attending IVF infertility center in maternity teaching hospital of Erbil City. *Open Journal of Obstetrics and Gynecology*, 2013(September), pp.577–585. Available at: http://file.scirp.org/Html/13-1430480_37028.htm
23. JAIN, M., SINHA, M. & SHUKLA, R.C. (2004). Transvaginal Doppler ultrasound with color flow imaging in luteal phase defect. *International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics*, **84** (3), pp. 266–7. [Online]. Available at: http://www.ncbi.nlm.nih.gov/pubmed/15001380.
24. KOCH, J, et al. (2012). Endometriosis and infertility - a consensus statement from ACCEPT (Australasian CREI Consensus Expert Panel on Trial evidence). *The Australian & New Zealand journal of obstetrics & gynaecology*, **52** (6), pp. 513–22. 00\[Online]. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23016798.
25. LANKFORD, J.C., Mancuso, P. & Appel, R., 2013. Congenital Reproductive Abnormalities. *Journal of midwifery & women's health*, pp. 546–551. Available at: http://www.ncbi.nlm.nih.gov/pubmed/24033893.
26. LA SALA, G. B., BLASI, I., GALLINELLI, A., DEBBI, C., LOPOPOLO, G., VINCI, V. & IANNOTTI, F. (2011). Diagnostic accuracy of sonohysterography and transvaginal sonography as compared with hysteroscopy and endometrial biopsy: a prospective study. *Minerva ginecologica*, **63**(5), 421-427.
27. LEE. HJ, Ku SY. (2011). Diagnosis and current treatment of Müllerian duct anomaly. *Korean J Obstet Gynecol.Mar*; **54**(3):132-139.
28. LETTERIE, G.S. (2011). Management of congenital uterine abnormalities. *Reproductive biomedicine*. **23** (1), pp.40–52. [Online]. Available at: http://www.ncbi.nlm.nih.gov/pubmed/21652266.
29. MAHESHWARI, A., HAMILTON, M, and BHATTACHARYA, S. (2008). Effect of female age on the diagnostic categories of infertility. *Human reproduction* (Oxford, England), **23** (3), pp. 538-542.
30. MASCARENHAS, M.N, et al. (2012). National, regional, and global trends in infertility prevalence since 1990: a systematic analysis of 277 health surveys. *PLoS medicine*, 9 (12), p.e1001356. [Online].
31. MCLAREN, JF. (2012). Infertility evaluation. *Obstetrics and gynecology clinics of North America*, 39 (4), pp. 453-463. [Online].
32. NIKNEJADI, M. et al. (2012). Diagnostic accuracy of transvaginal sonography in the detection of uterine abnormalities in infertile women. *Iranian journal of radiology: a quarterly journal published by the Iranian Radiological Society*, **9**(3), pp.139–44.
33. PATRELLITS, FRANCHI L, GIZZO S, SALVATI MA, BERRETTA R, PIANTELLI G, MODENA AB. (2013). Can the impact of pelvic inflammatory disease on fertility be prevented? Epidemiology, clinical features and surgical treatment: evolution over 8 years. *The Journal of reproductive medicine*, **58** (9-10), 425-433.
34. PAVONE, M. E., KING, J. A., & VLAHOS, N. (2006). Septate uterus with cervical duplication and a longitudinal vaginal septum: a müllerian anomaly without a classification. *Fertility and sterility*, **85** (2), 494-e9.
35. PFEIFER, D.G.(1995). The Role of Sonography in Diagnosing and Treating Female Infertility. Journal of

Diagnostic Medical Sonography, **11**(2), pp.61–66. Available at: http://jdm.sagepub.com/cgi/doi/10.1177/875647939501100203 [Accessed December 19, 2014].
36. PHILIPS. (2008). Choose versatility fully equipped. Koninklijke Philips Electronics N.V. [Online]. Available at: http://www.getech.com.tw/upload/files/product_log892/HD11XE_Brochure.p
37. QIAO, J., YANG, Y. & LI, R. (2012). Polycystic Ovary Syndrome: Fertility Management. *Current Obstetrics and Gynecology Reports*, 1 (4), pp.159–165.
38. RACKOW, B.W. & ARICI, A., 2007. Reproductive performance of women with müllerian anomalies. *Current opinion in obstetrics & gynecology*, 19, pp.229–237.
39. SADOW, C. & SAHNI, V. (2014). Imaging female infertility. *Abdominal imaging*, (September 2013), pp.92–107. [Online]. Available at: http://link.springer.com
40. SARAVELOS, S., COCKSEDGE, K. & LI, T. (2008). Prevalence and diagnosis of congenital uterine anomalies in women with reproductive failure: a critical appraisal. *Human Reproduction Update*, **14**(5), pp.415–429.
41. STEINKELER, J, et al. (2009). Female infertility: a systematic approach to radiologic imaging and diagnosis. *Radiographics : a review publication of the Radiological Society of North America, Inc*, **29** (5), pp.1353–70.
42. VIERA, A. & GARRETT, J.(2005). Understanding interobserver agreement: the kappa statistic. *Fam Med*, (May), **37**(5). pp.360–363. [Online]. Available at: http://www1.cs.columbia.edu/~julia/courses/CS6998/Interrater_agreement.Kappa_statistic.pdf.
43. WOELFER, B., SALIM, R. & BANERJEE, S. (2001). Reproductive outcomes in women with congenital uterine anomalies detected by three ‐ dimensional ultrasound screening. *Obstetrics & Gynecology,* **98** (6), pp.1099–1103. [Online].
44. WOLD, A. S. D., PHAM, N., & ARICI, A. (2006). Anatomic factors in recurrent pregnancy loss. *In Seminars in reproductive medicine*, 24(1), pp. 025-032. Copyright© 2006 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA.
45. ZAHALSKY, M. & NAGLER, H.M. (2001). Ultrasound and infertility: diagnostic and therapeutic uses. *Current urology reports*, **2** (6), pp.437–42.

Alyaa. M. Raheem: born in Karbolaa, 1-Jan- 1984, work as a technical trainer in the department of radiography in faculty of medical and health technology, middle technical university, 2005 and lecturer at the same department in 2015.
BSc in radiographic technology from faculty of medical and health technology, Iraq, and MSc in applying radiography from Sheffield Hallam University. UK. Corresponding author

Luma Naji : born in Dhi qar, Iraq , 21-May -1984, work as a technical trainer in the department of radiography in faculty of medical and health technology, middle technical university, Iraq 2006 and lecturer at the same department in 2017 BSc in radiographic technology from faculty of medical and health technology, Iraq, and MSc in physical Science from Kufa university, Al-Najaf, Iraq

Dr. Hawraa Imad Mageed Altimimi: born in Baquba\ Iraq 1 July 1978, Ministry of Health 2002, member of Iraqi Medical Association 2008 MBBCh from Al Mustansiriyah University college of Medicine at 2002 ;Master of Radiology from Ain shams University college of Medicine, Egypt, 2017