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ROLE OF ULTRASOUND IN SCREENING OF FEMALE INFERTILITY: A SYSTEMATIC REVIEW

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Abstract

Several potential causes of female infertility can be evaluated through sonography, a diagnostic medical procedure that uses high-frequency sound waves to produce images of the inside of the body. A large proportion of women seeking gynecologic services are dealing with female infertility. This systematic review aimed to elaborate the sonography as a beneficial tool for determining female infertility and its leading risk factors. We performed a systematic review using sonography to evaluate the most common causes of infertility. From 2001 to 2020, a search was conducted through Google Scholar, PubMed, NCBI, and Medscape databases. A Microsoft Excel spreadsheet was used to tabulate the data. Data were analysed with SPSS version 24 software, the Statistical Package for the Social Sciences. Sonography revealed that the following factors contributed to infertility in 12 studies: polycystic ovarian syndrome (PCOS), 44.9%; fibroids, 43.6%; endometriosis, 33.3%; polyps, 29.5%;

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adhesions, 29.5%, pelvic inflammatory disease, 23.1%; ovarian cysts, 23.1%; congenital anomalies, 20.5%; and adenomyosis, 11.5%. With sonography, PCOS is the most common cause of infertility, while adenomyosis is the least common cause.

INTRODUCTION

Ultrasound is a common diagnostic tool used to evaluate the female reproductive system and assess fertility (Campbell 2019). It can be used to visualise the uterus, fallopian tubes, and ovaries and to assess the thickness and appearance of the endometrial lining (Tur-Kaspa, Gal et al. 2006). Ultrasound can also monitor an embryo's growth and development during pregnancy (Hackelöer 1984).

Several types of ultrasound exams may be used to evaluate female fertility, including Transvaginal ultrasound: A transvaginal ultrasound is an exam that uses a small, handheld device called a transducer inserted into the vagina (Campbell 2019, Campbell 2019). This type of ultrasound provides a close-up view of the uterus, fallopian tubes, and ovaries. Pelvic ultrasound: A pelvic ultrasound is an exam that uses a transducer placed on the abdomen to visualise the reproductive organs. This type of ultrasound is typically used to evaluate the uterus and ovaries for abnormalities or to monitor the growth and development of an embryo during pregnancy. 3D ultrasound: A 3D ultrasound uses special software to create a three-dimensional image of the uterus and other reproductive organs. This can be helpful for identifying abnormalities or for evaluating the endometrial lining (Dishuck, Perchik et al. 2019).

Female infertility is defined as the inability to conceive after one year of regular, unprotected sex or the inability to carry a pregnancy to term. It is a common problem, affecting approximately 10-15% of couples trying to conceive (Mohammed, MAYSA et al. 2020).

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There are many possible causes of female infertility, including Ovulation disorders: Ovulation disorders, such as polycystic ovary syndrome (PCOS), can interfere with the release of an egg from the ovary (Derchi, Serafini et al. 2001). Fallopian tube damage: Fallopian tubes can be blocked or damaged, making it difficult for an egg to travel from the ovary to the uterus. Uterine or cervical abnormalities: Structural abnormalities of the uterus or cervix can prevent a fertilised egg from implanting in the uterus or can cause a miscarriage. Endometriosis: This is a condition in which the tissue that lines the uterus grows outside of the uterus, causing inflammation and scarring. Age: Female fertility begins to decline in the late 20s and early 30s and continues to decline as a woman gets older (Abdennebi, Pasquier et al. 2022).

Many treatment options are available for female infertility, including medication to stimulate ovulation, surgery to repair damage to the reproductive organs, and assisted reproductive technologies such as in vitro fertilisation (IVF) (Grigore and Mare 2009). The most appropriate treatment option will depend on the underlying cause of infertility. Ultrasound can be an important diagnostic tool for evaluating female fertility and identifying potential causes of infertility, such as uterine fibroids, polycystic ovary syndrome (PCOS), and endometriosis. It can also be used to monitor the response to fertility treatments and assess a pregnancy's health. The current review will elaborate on the role of ultrasound in screening for female infertility.

METHOD AND MATERIALS

For the literature review, search engines were used, including google scholar, Pubmed, NCBI and Medscape. The time period was from 2017-2020. Manual referencing was carried out once duplicate articles were screened. Screening of relevant data, including titles and abstracts, was done. This resulted in the accumulation of a total of 12

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studies after thorough screening. Studies were screened out and removed on the basis of duplication and insufficient data and the basis of title and abstract.

The studies that were included according to inclusion criteria were retrospective cohort, observational, cross-sectional and descriptive studies. Studies that were associated with infertility in females were of interest. The excluded studies were review articles, case studies and case series. Moreover, two investigators reviewed and assessed the studies before their inclusion. Studies were shown in a tabulated form (table 1) containing the author's name, publication year, sample size, study design and other contributing factors associated with infertility. The Statistical Package for the Social Sciences (SPSS), version 24 (SPSS 24; IBM, Armonk, NY, USA) software was used for evaluation and analysis.

RESULTS

After careful review and study, 12 studies were included from the collected 25 articles. On the basis of detection percentage, different factors related to infertility in females were found and calculated as listed in table 1. According to the data collected and analysed, it was observed that polycystic ovarian syndrome is the most common and frequent factor among females with infertility. It was found out with sonography. The percentages were 44.9%. Other factors that were associated with infertility followed by the said factor were fibroid development at 43.6% and endometriosis at 33.3%. Sonography also detected endometrial polyps that contributed to 29.5% of infertility cases. But the infertility rate of ovarian cysts and pelvic inflammatory disease was 23.1%, followed by 20.5% of infertility by uterine congenital anomalies and adenomyosis was 11.5% as shown in table 2.

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Table 1: The list of the shortlisted papers for the current review article

Author	Title	Sample Size	Study Design	Sonographic Cause of Infertility
Saima Farooq 2020	Endometrial hyperplasia in polycystic ovarian syndrome patients having raised endometrial thickness	90	Cross-sectional	PCOS
Farhana Haider 2020	Frequency of Common Infertility Causes in Patients attending Infertility Clinic of Nishtar Hospital Multan	100	Cross-sectional	PCOS, Endometrisosis
Adeleh Dadkhah 2020	Evaluation of Changes in Doppler Sonographic indices of Uterine and Ovarian Arteries in Women with Endometriosis and Infertility	155	Cross-sectional	Fibroids, Polyp, Endometriosis, Adenomyosis ,Adhesions, Cyst

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Meher.B Ali 2020	Female's Infertility Rules of Ultrasound And Colour Duplex in Assessment of Pelvic Causes	750	Retrospective	PCOS, Fibroids, Endometriosis, Anaomlies, Cyst
Maysa S 2020	Ultrasound Role in Management of Female Infertility	30	Cross-sectional	PCOS, Fibroids, Polyp, Adenomyosis, Adhesions, Anaomlies, Cyst
Ayesha Ahmad 2020	Transvaginal Ultrasonographic Findings of Infertile Females in Population of Lahore	138	Cross-sectional Descriptive	PCOS, Fibroids, Polyp, Endometriosis, PID, Adenomyosis, Cyst
Tommaso Capezzuoli 2020	Ultrasound findings in infertile women with endometriosis: evidence of	419	Retrospective cohort	Fibroids, Endometriosis, Adenomyosis

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	concomitant uterine disorders			
Munazzah Rafique 2020	Risk of Infertility Index in Women with polycystic ovarian syndrome	50	Retrospective	PCOS
Rubina Izhar 2019	Fertility outcome after saline sonography guided removal of intrauterine polyps in women with unexplained infertility	92	Prospective case-control	Polyp
Ruth Gomez 2019	Fertility After Ovarian Cystectomy: How Does Surgery Affect IVF/ICSI Outcomes?	550	Retrospective Cohort	Endometriosis, Cyst
Priyanka Sanjay 2019	Causes and Prevalence of Factors Causing Infertility in a Public Health	120	Cross-sectional	PCOS, Endometriosis

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	Facility			
Sayed Tanveer Abbas Gilani 2018	Disorders leading to infertility in males and females	200	Cross-sectional Analytical	PCOS, Polyp, PID

Table 2: Frequencies and percentages of the pathological conditions responsible for female infertility

Pathological Conditions Responsible for Infertility	Frequency	Percentages
PCOS	35	44.9%
Fibroids	33	43.6%
Endometriosis	26	33.3%
Adhesions	23	29.5%
PID	18	23.1%
Cysts	18	23.1
Anomalies	16	20.5%
Adenomyosis	9	11.5%

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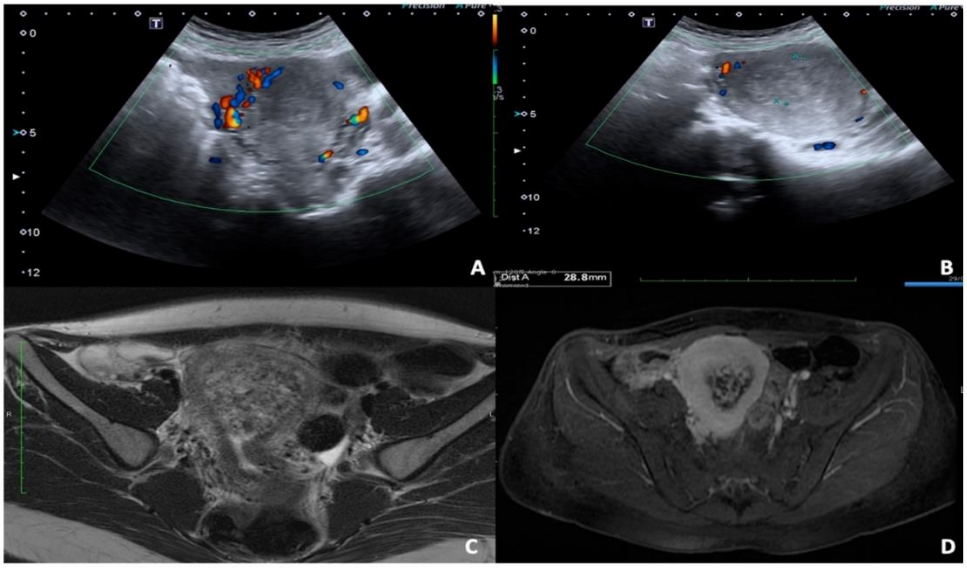

Figure 01: The role of U.S in the assessment and diagnosis of pain during pregnancy

(Caruso, Dell'Aversano Orabona et al. 2022)

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Figure 02: Transvaginal ultrasonographical assessment and female infertility (Chizen 2010)

Figure 03: Transvaginal ultrasonography and female infertility (Chizen 2010)

DISCUSSION

The failure or inability to conceive after twelve months of sexual intercourse is regarded as infertility. It has psychological effects on females and is considered traumatic for them. After studying multiple research studies, the present literature review associated infertility with PCOS as the most common among women. One of the studies carried out by schmid et al. has found that the most common endocrine issue is PCOS, which can cause 46% infertility followed by 33.8% due to tubal pathology (Azziz, Sanchez et al. 2004). However, another study showed a contrasting result which associated infertility with fallopian tubes.

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Menstrual disorder is also considered as another factor of infertility by masoumi et al., who found a prevalence of 62.6% in infertile individuals (Onwuchekwa and Oriji 2017).

The Fibroid effect is also considered one of the major effects that can cause infertility. In the current review, it was found that 43.6% of patients have been affected due to it. The diagnosis was made by sonography. One of the studies carried out by Guo and Segars has detected the presence of fibroid development in 5-10% of cases. However, it is not the case for all types of fibroids. It may lead to infertility in all women. Studies have shown that submucosal and intramural patients are associated with low pregnancy rates, while sub-serosal showed no or little effect. Endometriosis is also a cause of infertility and is reported by bulleti et al. to be the cause in 30-50% of cases (As-Sanie, Black et al. 2019). It is the case of explained fertility in women as described by Navarro et al. Due to this reason in the initial stages of endometriosis, the frequency of pregnancy is lower in women.

The current study also found that the detection of infertility with sonography resulted in the observation of endometrial polyps (Garrido, Navarro et al. 2002). The result is in accordance with another study reported by Nikjang et al. in primary infertility. It is found with a high prevalence of 8-38% cases as compared to secondary infertility of 1.8-17%. However, Perez medina showed contrasting results and gave little importance to it as the cause of infertility. In their study, diamond et reported adhesion as the cause of infertility as they are important regarding impaired organs' function, reduced fertility rate, intestinal blockage, pain in some cases and difficult reoperation. Kodaman and arici showed in their study that it might not be the sole factor and undermine adhesion as the cause of reduced fertility. They associated it on the basis of their thickness, position, and

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extent, which should be assessed before considering it as a factor (Garrido, Navarro et al. 2002).

PID was considered the cause of infertility, and the diagnosis was made by sonography in this particular study. The same was reported by tsevat et al. and also a manageable and preventable cause. The ovarian cyst is also a cause of infertility. However, all of its types are not associated with infertility. The study by Legendre et al. observed and reported the same results. Uterine anomalies were also detected sonographically as and cause of infertility in this study. However congenital uterine anomalies are the cause of reduced fertility or not is still debatable and unclear. Further research work is needed in this case. It is considered a factor of infertility in the case of gestational implantation and placentation (Corroenne, Legendre et al. 2018).

The prevalence of septate uteruses is higher among women suffering from infertility than among fertile women. Infertile women are more likely to have unicornuate and hypoplastic uteruses. The prevalence of an arcuate uterus is lower among fertile women. The least common cause of infertility detected by sonography is adenomyosis (Hassan, Lavery et al. 2010). Furthermore, Barbosa-Silva and Barros stated that uterine adenomyosis remains a relatively common and debilitating disease among infertile women (Campbell 2019).

LIMITATIONS

Mainly open access journal was used to download the papers where research articles are free of cost. Because of shortage of the fund and fees, we were unable to access the paid papers. Moreover, its not a meta-analysis, to generalizes its results and implement it on the society.

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