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**ORIGINAL ARTICLE**

# Comparative Study of Diagnostic Accuracy of Ultrasonography Vs Histopathology in patients Undergoing Hysterectomy due to Uterine Pathologies

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## ABSTRACT

**Background:** Accurate diagnosis of uterine pathologies has become a core part when referring patients for hysterectomy. A variety of modalities can be used for the diagnosis of uterine abnormalities.

**Aims:** To evaluate the accuracy of ultrasound in diagnosing various uterine pathologies and to compare histopathological findings with ultrasonographical findings.

**Methods:** A cross-sectional study was conducted on 80 females who met the inclusion criteria at Department of Gynaecology, University of Lahore Teaching Hospitalover a period of 9 months from November 2020 to August 2021. The study was started after the approval of ethical committee at the University of Lahore. All the patients were enrolled in this study after signing the informed consent form. Patients preop ultra-sonographic findings and post-operative histopathology reports of the hysterectomy was analyzed and sensitivity, specificity and diagnostic accuracy of ultrasonography for uterine pathologies was calculated.

**Results:** Majority of the patients were in 40's age group. Most common sonographical indication for hysterectomy was fibroids, followed byadenomyosis and endometrial hyperplasia. The overall sensitivity, specificity and diagnostic accuracy values for ultrasonography in the diagnosis of uterine abnormality was satisfactory. The diagnostic accuracy of ultrasonography in detection of uterine fibroids and adenomyosis was 96.25% and 98.75%.

**Conclusion:** Histo-pathological analysis correlates well with the pre-operative sonographical diagnosis. The diagnostic accuracy of ultrasound in detecting intrauterine pathology urges us to utilize ultrasonography as a first-line investigation in gynaecological patients. It is a valuable adjunctive to histopathoology with high accuracy for identification and characterization of uterine pathologies.

**Keywords:** Ultrasound, Menorrhagia, Fibroids, Adenomyosis, Endometrial hyperplasia.

## INTRODUCTION

Hysterectomy is ranked as the second most common surgical procedure in department of obstetrics & gynaecology, after cesarean section.[1] Its rate varies from 6.1 to 8.6 per 1000 women of reproductive ages.[2] Its incidence vary all over the world.[3] It varies from place to place on the basis of clinical factors[4]. It is estimated to be higher in developing countries than in West, the America (5.1/1000)[5], Australia (4.7/1000)[6], and Germany (3.6/1000)[7]. In Pakistan, the rate of hysterectomy has not been calculated but an increased frequency of hysterectomies with the passage of time in total gynecological admissions has been reported,as it is the only option if the patient do not respond to the medical treatment[8]. Hysterectomy is ranked as one of the most common elective surgical procedures worldwide.[9]The gynecologic tract is fourth most common site of cancer after breast, lungs and gastrointestinal cancers[10]. The sixth most frequent form of cancer in women worldwide is the endometrial carcinoma[11] and hysterectomy is accepted as the treatment for all malignant pelvic pathologies.[12] However, in case of benign pelvic diseases, such as uterine fibroids, endometrial polyps, adenomyosis, abnormal uterine bleeding and uterine prolapse, it is considered when other treatment options fail[13,14].

Hysterectomy is a surgery that involves the removal of the uterus[13]. On basis of resection technique, it can be total or subtotal[15]. The laparoscopic hysterectomy further includes total laparoscopic, laparoscopic supra-cervical and laparoscopic-vaginal hysterectomy[16]. Indications for hysterectomy varies from benign to malignant lesions of the female genital tract[17]. The most common gynecological indications of hysterectomy are abnormal uterine bleeding, fibroids, pelvic prolapse, premalignant and malignant lesions of the uterus, cervix, fallopian tubes or ovaries[15]. Abnormal uterine bleeding can be due to benign or malignant lesions of

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uterus.In 2011, an PALM-COEIN acronym was designed by the International Federation of Gynecology and Obstetrics for the causes of abnormal uterine bleeding which includes polyps, adenomyosis, leiomyoma, hyperplasia/malignancy, coagulopathy, endometrial, ovulatory disorders, iatrogenic and not otherwise classified pathologies[18]. The nomenclature was modified further in year 2018 and it included the sub-classification of leiomyoma on the basis of ultrasound findings[19]. The National Institute for Health and Care Excellence recommends hysterectomy as the second line treatment for bleeding, when pharmacological, hormonal and less invasive procedures have failed[20].

The pelvis is divided structurally by an oblique plane from sacral promontory to the superior margin of the pubic symphysis into 2 compartments, true and the false pelvis. The true pelvis is bounded anteriorly by pubis bone and its rami, posteriorly by sacrum and coccyx, laterally by fused ilium and ischium, and inferiorly by the pelvic floor muscles. The false pelvis is bounded anteriorly by abdominal wall, posteriorly by sacrum and laterally by portions of the iliac bones[21]. The uterus is an organ responsible for functions such as menstruation, gestation, labor and delivery. Anatomically, the uterus is located in pelvis anterior to the rectum and posterior to the urinary bladder[22]. Normally the uterus and collapsed urinary bladder are present in true pelvis but as the bladder fills, the dome of the bladder extends into the false pelvis providing an acoustic window by displacing the bowel loops superiorly providing an acoustic window for trans-abdominal ultrasound imaging[21].

Ultrasound is recognized as the primary imaging modality in evaluation of female pelvis[23]. Trans-vaginal ultrasound allows visualization of the pelvic viscera in true pelvis[21]. Ultrasound modality can differentiate benign and malignant pelvic pathologies by the subjective evaluation on gray-scale ultrasound and can often make a specific diagnosis on basis of pattern recognized on the gray-scale ultrasound image. Trans-abdominal approach is

preferred to identify pelvic pathology and pregnancy whereas the trans-vaginal ultrasound is suggested as the first line imaging modality for reproductive age females with acute pelvic pain because of easy accessibility, lesser ionizing radiation and efficiency in identifying pelvic disorders[24]. In patients of endometrial tumor, TVS has been extensively used to assess depth of myometrial invasion[25,26]. Doppler techniques are used to evaluate vascularity[23].

The objectives of the study were to evaluate the diagnostic accuracy of ultrasound in uterine pathologies and to compare ultrasonographical findings with histopathological findings.

## MATERIAL AND METHODS

This study was a cross-sectional study performed on 80 females at Department of Gynaecology, University of Lahore Teaching Hospital after approval of Research Center Ethical Committee. Inclusion criteria was married, multiparous female 18-45 years of age with clinically suspected uterine pathology diagnosed on ultrasound and confirmed on histopathology. Exclusion criteria was the patient who refused hysterectomy after being advised and the patient who opt for medical treatment for uterine pathology.

Ultrasound was performed using Canon APLIO 300 ultrasound machine. The endometrial cavity was inspected in two perpendicular plane sagittal and transverse views. Uterine cavity abnormalities including uterine fibroids, uterine adenomyosis, endometrial hyperplasia and polyp lesions were investigated.

Fibroid is common hormone sensitive, benign gynaecological tumour that originates from the smooth muscle layer and is seen on sonography as a well - circumscribed mixed or hypoechoic mass lesion that originates from the myometrium, interrupts the endometrial stripe and have characteristic acoustic shadowing. Adenomyosis is defined as the benign invasion of the endometrium into the myometrium. Both endometrial glands and endometrial stroma must be present. Endometrial hyperplasia is a condition of excessive proliferation of the endometrial cells and appears on ultrasound as thickened endometrium. Endometrial polyps refer to outgrowths of endometrial glands and stroma within the uterine cavity. They are endometrial epithelial proliferations and appears on ultrasound as round or oval localized echogenic lesion located in the endometrial cavity, sometimes with an echogenic bright rim with intact endometrial-myometrial junction.

Histopathology was performed at Pathology Department of University of Lahore Teaching Hospital. All women with significant sonographical diagnosis underwent operative hysterectomy and the specimens obtained were sent for histopathological examination. The surgical specimens were fixed in 10% formalin and embedded in paraffin. The blocks were sectioned and stained with hematoxylin and eosin stain for detailed microscopy.

Sensitivity, specificity and diagnostic accuracy of ultrasound was calculated in the patients who underwent hysterectomy for uterine diseases, with histopathological findings used as the gold standard. Data were analyzed using SPSS Statistics 25.

## RESULTS

During nine-month study period, 80 hysterectomy specimens were analyzed between November 2020 and August 2021. A correlation between demography, preoperative clinical and ultrasonographic findings, indication and type of surgery and histopathological examination was studied.

Of these 80 cases, almost 25% women belonged to the age group of 42 years, 20% to 45 years and 17.5% to 40 years of age (Figure.1). Almost 16% of the hysterectomies were performed in females less than 40 years of age. When dividing patients into age groups, 16% of the patients were < 40 years of age and 84% of hysterectomies were performed in females of more than or around 40 years of age as uterine diseases were more prevalent among this age group.

Indications of hysterectomy varied from abnormalities of menstrual cycle to suspected malignancy of pelvis. On ultrasonography, 97.5% hysterectomies were performed for benign diseases and 2.5% were for performed with suspicion malignant disease.On ultrasonography, in many hysterectomy cases pre-operative sonography revealed fibroid in 50(62.5%) cases (Fig. 2). Adenomyosis was marked among 12 females (15%), endometrial hyperplasia in 10(12.5%) and endometrial polyp in 8(10%) cases. On histopathology, leiomyoma: benign tumor of smooth muscles was the commonest pathology found in 47(58.8%) cases (Fig. 3).

In case of adenomysosis, ultrasound provides information with a specificity of 98.5% and sensitivity of 100%, whereas the diagnostic accuracy of ultrasound in diagnosis adenomyosis is 98.75%. Ultrasonography is a great ally in diagnosing endometrial hyperplasia with sensitivity 75% and specificity of 98.53%, whereas the diagnostic accuracy of ultrasound in diagnosis endometrial hyperplasia is 95%.For the cases with endometrial polyps, ultrasonography aids in the diagnosis with sensitivity 100% and specificity of 98.6%, whereas the diagnostic accuracy of ultrasound in diagnosing endometrial polyps is 98.75% (Table 1-4). Sensivity, specificity and diagnostic accuracy of ultrasound in uterine pathologies is summarised in Table.5.

Table 1: Cross tabulation-fibroid on ultrasound versus fibroid on histopathology

| Fibroid On USG | Fibroid On Histopathology | | Total |
|---|---|---|---|
| | Yes | No | |
| Yes | 47 | 3 | 50 |
| No | 0 | 30 | 30 |
| Total | 47 | 33 | 80 |

Table.2. Cross tabulation-Adenomyosis On Ultrasound Versus Adenomyosis On Histopathology

| Adenomyosis On USG | Fibroid On Histopathology | | Total |
|---|---|---|---|
| | Yes | No | |
| Yes | 11 | 1 | 12 |
| No | 0 | 68 | 68 |
| Total | 11 | 69 | 80 |

Table.3. Cross tabulation-Endometrial Hyperplasia On Ultrasound Versus Endometrial Hyperplasia On Histopathology

| Endometrial Hyperplasia USG | Fibroid On Histopathology | | Total |
|---|---|---|---|
| | Yes | No | |
| Yes | 9 | 1 | 10 |
| No | 3 | 67 | 70 |
| Total | 12 | 68 | 80 |

Table.4. Cross tabulation-Endometrial Polyp On Ultrasound Versus Endometrial Polyp On Histopathology

| Endometrial Polyp On USG | Fibroid On Histopathology | | Total |
|---|---|---|---|
| | Yes | No | |
| Yes | 7 | 1 | 8 |
| No | 0 | 72 | 72 |
| Total | 7 | 73 | 80 |

Table.5. Diagnostic Indices of Ultrasound in Diagnosing Abnormal Uterine Pathologies.

| Uterine abnormalities | Diagnostic indices | | |
|---|---|---|---|
| | Sensitivity | Specificity | Diagnostic Accuracy |
| Fibroids | 100% | 90% | 96.25% |
| Adenomyois | 100% | 98.5% | 98.75% |
| Endometrial hyperplasia | 75% | 98.53% | 95% |
| Endometrial polyp | 100% | 98.6% | 98.75% |

Fig.1: Age wise distribution of hysterectomy cases.

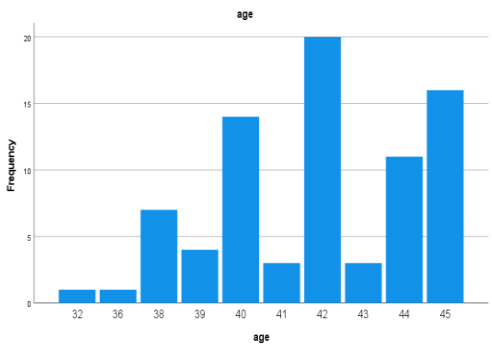


Fig. 2: Sonographical findings of hysterectomy cases.

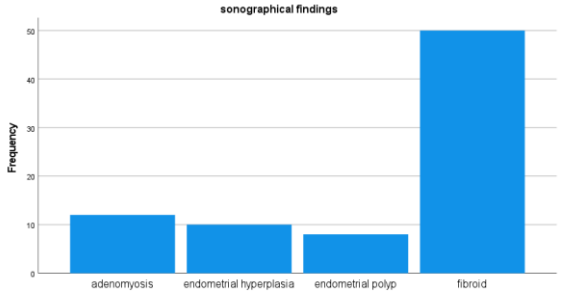
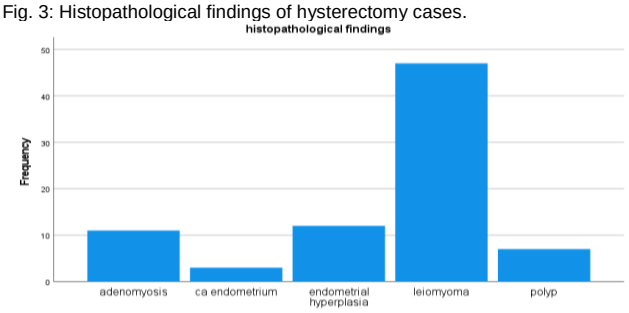



Fig. 3: Histopathological findings of hysterectomy cases.




## DISCUSSION

In our study 80 symptomatic patients underwent hysterectomy after ultrasonographic indication of surgery and specimens were sent for histopathology.

The clinical presentation and indications for hysterectomy vary from benign uterine pathologies to malignant tumors. Hysterectomy provides definitive cure to diseases which involve uterus in cases such as fibroids, adenomyosis, endometrial hyperplasia and malignancies of genital tract.

In our study the maximum incidence of hysterectomy is found is females of 40-45 years with the maximum number of patients as 42 years of age. The mean age of patients is 41.8 years. Almost similar incidence was reported by Selvi T et al and in other prospective studies[27-29]. Rashid et al reported that most of the females who underwent hysterectomy were 41 to 50 years of age, with 44.64 years as a mean age[30]. Neelgund SM et al reported same age range for the patients undergoing hysterectomy and mean age was found to be 45 years in their study[31].

The most common clinical symptoms reported in our study is menorrhagia (72.5%), followed by mass per abdomen (13.8%). This is similar to the study of Neegland reported the main presenting complaint was menorrhagia (63.4%)[31]. Mahmoud Khaniki et al reported that AUB was the main complaint in about 62.2% patients followed by abdominal pain in 13.3% and uterine prolapse in 7.4% of the patients[32]. The study by Shergill SK reported menorrhagia as the chief presenting symptom in 66% women undergoing hysterectomy[33].

In our study most of the patients underwent total abdominal hysterectomy and bilateral salphingo oophorectomy. In a study carried out at Nigera, incidence of TAH and BSO is reported to be 81.7%[34]. The commonest benign lesion was fibroid uterus, present in 62.5% cases, which is similar to the results reported in the study of Gupta et al and Khan R et al[35-36]. Neena et al reported adenomyosis as is an indication for hysterectomy is 10% of the cases and utero-vaginal prolapse among 18% of the females[37].

Histopathological diagnosis of our study revealed leiomyoma as predominant pathology among various hysterectomy specimens. Leiomyoma is found in 58.8% cases followed by endometrial hyperplasia in 15% and adenomyosis in 13.8%of the cases. Therefore, fibroids are labelled as most frequent indication of hysterectomy. The incidence of leiomyoma is about 20% in women of reproductive age group and its incidence increases with age[38]. The commonest benign pathology of uterus identified on histopathological analysis is leiomyoma. Pathak V et al.[39] and Baral R et al.[40] reported high incidence of leiomyomas consistent to the findings seen in our study. In contrast to the our results lower values of incidence of leiomyomas on histopathology were observed in other studies.[41-42]Adenomyosis is another observed pathology on hysterectomy specimens for AUB. Diagnosis of adenomyosis is difficult during preoperative period as uterus seems to be bulky on ultrasound but specific diagnosis of adenomyosis cannot be made solely on ultrasonography and can only be confirmed after hysterectomy on histopathological assesment[43]. In our study adenomyosis is prevalent among 13.8% of the hysterectomy specimens. Neelgund SM et al[31] and Sobande et al[44] also reported similar results in case of adenomyosis. Endometrial hyperplasia was observed in 15% cases of our study. Similar results were reported by Ranabhat et al. in their study[45]. Nearly same findings were reported by Isaoglu U[46]. In contrary to the results found in our study, Ojeda et al[47] reported more cases (22.3%) endometrial hyperplasia to be found in (22.3%).

In present study, Cross tabulation of the results of uterine pathologies on ultrasound versus uterine pathologies on histopathology revealed significant correlation (Table 1-4). Sensivity, specificity and diagnostic accuracy of ultrasound in uterine pathologies is summarised in Table 5.

The study revealed that ultrasonography has sensitivity of 100% and specificity of 90% in diagnosing uterine fibroidsand a diagnostic accuracy of96.25%. The results of our study were similar to those reported by Veena and Shivalingaiah who reported an accuracy rate of 96.7%[48]. Adriana Elisa et al demonstrated the diagnostic accuracy level of 87.9% in diagnosing fibroids while using ultrasonography[49]. A study conducted on 643 infertile women by Niknejadi et al. reported similar sensitivity (89.2%) and specificity (92.5%) as described in their study[50].

In case of adenomysosis, ultrasound provides information with a specificity of 98.5% and sensitivity of 100%, whereas the diagnostic accuracy of ultrasound in diagnosis adenomyosis is 98.75%. A retrospective study carried out on 80 women with preoperative diagnosis of adenomyosis on abdominal scan by Siedler and coworkers had a sensitivity of 63% and and a specificity of 97% for adenomyosis.[51] Adriana Elisa reported 84.3% sensitivity of pelvic sonography for the detection of adenomyosis.[49] On histopathologically proven cases of adenomyosis, Reinhold and colleagues also reported a sensitivity and specificity of ultrasound both as 86% in identification of cases with adenomyosis[52]. Botsis and coauthors reported a specificity of 90% and sensitivity of 80% in patients with diffuse adenomyosis.[53] Another study carried out by Brosens and coworkers reported a sensitivity and specificity of transvaginal ultrasonography as 86% and 50% in the diagnosing adenomyosis[54].

With respect of diagnosing endometrial hyperplasia, our study revealed the sensitivity of 75% and specificity of 98.5%, whereas the diagnostic accuracy of ultrasound in diagnosis endometrial hyperplasia is 95%. Adriana Elisa et al demonstrated diagnostic accuracy of 47.6%, sensitivity and a specificity of 68.7% and 41.7% in diagnosing cases of endometrial thickening.[49] Results of our study were higher than those observed in studies carried out by Veena and Shivalingaiah[55] who described diagnostic accuracy of 88.33%, Wanderley et al[56] who reported an accuracy of 63.2% and Niknejadi et al[57] who described a sensitivity of 56.2% and specificity of 99.6% respectively.

Ultrasonography is an excellent technique in detection of polyps, we found the sensitivity 100% and specificity of 98.6%, whereas the accuracy of ultrasound in diagnosing polyps is 98.75%. Our results were consistent to the previously described reports by other authors[48,50,58].

## CONCLUSION

Histopathological analysis correlates well with the pre-operative sonographical diagnosis. The diagnostic accuracy of ultrasound in detecting intrauterine pathology urges us to utilize ultrasonography

widely to diagnose uterine pathologies. In conclusion, ultrasound is a first line approach for detection of uterine pathologies and referring patients for hysterectomy.

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## REFERENCES


1. Cohen SL, Vitonis AF, Einarsson JI. Updated hysterectomy surveillance and factors associated with minimally invasive hysterectomy. JSLS: Journal of the Society of Laparoendoscopic Surgeons. 2014 Jul;18(3).
2. Al-Kadri HM, Al-Turki AH, Mo AM. Short and long term complications of abdominal and vaginal hysterectomy for. Saudi Med J. 2002;23(7):806-10.
3. Desai S, Campbell OM, Sinha T, Mahal A, Cousens S. Incidence and determinants of hysterectomy in a low-income setting in Gujarat, India. Health policy and planning. 2017 Feb 1;32(1):68-78.
4. Rather GR, Gupta Y, Bardhwaj S. Patterns of lesions in hysterectomy specimens: a prospective study. JK science. 2013 Apr 1;15(2):63.
5. Whiteman MK, Hillis SD, Jamieson DJ, Morrow B, Podgornik MN, Brett KM, Marchbanks PA. Inpatient hysterectomy surveillance in the United States, 2000-2004. American journal of obstetrics and gynecology. 2008 Jan 1;198(1):34-e1.
6. Wilson LF, Pandeya N, Mishra GD. Hysterectomy trends in Australia, 2000–2001 to 2013–2014: joinpoint regression analysis. Acta obstetricia et gynecologica Scandinavica. 2017 Oct;96(10):1170-9.
7. Stang A, Merrill RM, Kuss O. Hysterectomy in Germany: a DRG-based nationwide analysis, 2005–2006. Deutsches Ärzteblatt International. 2011 Jul;108(30):508.
8. Anbreen F, Qadir S, Naeem H, Farhat N. Type, time-trend and indications of hysterectomy. Gomal Journal of Medical Sciences. 2018Dec 31;16(4):92-6.
9. Stoller N, Wertli MM, Zaugg TM, Haynes AG, Chiolero A, Rodondi N, Panczak R, Aujesky D. Regional variation of hysterectomy for benign uterine diseases in Switzerland. PloS one. 2020 May 14;15(5):e0233082.
10. Berek JS, Bast RC Jr. Epithelial Ovarian Cancer. In: Kufe DW, Pollock RE, Weichselbaum RR, et al., editors. Holland-Frei Cancer Medicine. 6th edition. Hamilton (ON): BC Decker; 2003. Available from:
11. Ferlay J, Soerjomataram I, Ervik M, Dikshit R, Eser S, Mathers C, Rebelo M, Parkin DM, Forman D, Bray F. GLOBOCAN 2012: estimated cancer incidence, mortality and prevalence worldwide in 2012. Int J Cancer. 2012;136:E359-86.
12. Koh WJ, Abu-Rustum NR, Bean S, Bradley K, Campos SM, Cho KR, Chon HS, Chu C, Cohn D, Crispens MA, Damast S. Uterine neoplasms, version 1.2018, NCCN clinical practice guidelines in oncology. Journal of the National Comprehensive Cancer Network. 2018 Feb 1;16(2):170-99.
13. Thurston J, Murji A, Scattolon S, Wolfman W, Kives S, Sanders A, Leyland N. No. 377-hysterectomy for benign gynaecologic indications. Journal of Obstetrics and Gynaecology Canada. 2019 Apr 1;41(4):543-57.
14. Neis KJ, Zubke W, Römer T, Schwerdtfeger K, Schollmeyer T, Rimbach S, Holthaus B, Solomayer E, Bojahr B, Neis F, Reisenauer C. Indications and route of hysterectomy for benign diseases. Guideline of the DGGG, OEGGG and SGGG (S3 Level, AWMF Registry No. 015/070, April 2015). Geburtshilfe und Frauenheilkunde. 2016 Apr;76(4):350.
15. Colmorn LB, Krebs L, Langhoff-Roos J, NOSS study group. Potentially avoidable peripartum hysterectomies in Denmark: a population based clinical audit. PloS one. 2016 Aug 25;11(8):e0161302.
16. Turner LC, Shepherd JP, Wang L, Bunker CH, Lowder JL. Hysterectomy surgical trends: a more accurate depiction of the last decade? American journal of obstetrics and gynecology. 2013 Apr 1;208(4):277-e1.17.
17. Medhi P, Dowerah S, Borgohain D. A histopathological audit of hysterectomy: experience at a tertiary care teaching hospital. International J of Contemporary Medical Research. 2016;3(4):1226-8.
18. Munro MG, Critchley HO, Broder MS, Fraser IS, FIGO Working Group on Menstrual Disorders. FIGO classification system (PALM-COEIN) for causes of abnormal uterine bleeding in nongravid women of reproductive age. International Journal of Gynecology & Obstetrics. 2011 Apr 1;113(1):3-13.
19. Munro MG, Critchley HO, Fraser IS, FIGO Menstrual Disorders Committee, Haththotuwa R, Kriplani A, Bahamondes L, Füchtner C, Tonye R, Archer D, Abbott J. The two FIGO systems for normal and abnormal uterine bleeding symptoms and classification of causes of abnormal uterine bleeding in the reproductive years: 2018 revisions. International Journal of Gynecology & Obstetrics. 2018 Dec;143(3):393-408.
20. Heavy Menstrual Bleeding: assessment and management National Institute for Health and Clinical Excellence (NICE); 2018. NICE guideline Published: 14 March 2018. Online from www.nice.org.uk/guidance/ng88. Retrieved on 5th Oct, 2020.
21. Langer J. Normal anatomy of the female pelvis and transvaginal sonography. Callen's Ultrasonography in Obstetrics and Gynecology. 2017:805-24.
22. Chaudhry SR, Imonugo O, Chaudhry K. Anatomy, Abdomen and Pelvis, Ligaments. [Updated 2020 Apr 29]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK493215/ Retrieved on 5th Oct,2020.
23. Miccò M, Sala E, Lakhman Y, Hricak H, Vargas HA. Imaging features of uncommon gynecologic cancers. American Journal of Roentgenology. 2015 Dec;205(6):1346-59.
24. Tamilarasan V, Ameen M, Jadhav V. Transabdominal Ultrasonographic Evaluation of Pelvic Masses and Comparsion with Transvaginal Ultrasonography. International Journal of Contemporary Medicine Surgery and Radiology. 2019;4(3):C86-C89.
25. Andreano A, Rechichi G, Rebora P, Sironi S, Valsecchi MG, Galimberti S. MR diffusion imaging for preoperative staging of myometrial invasion in patients with endometrial cancer: a systematic review and meta-analysis. European radiology. 2014 Jun 1;24(6):1327-38.
26. Antonsen SL, Jensen LN, Loft A, Berthelsen AK, Costa J, Tabor A, Qvist I, Hansen MR, Fisker R, Andersen ES, Sperling L. MRI, PET/CT and ultrasound in the preoperative staging of endometrial cancer—a multicenter prospective comparative study. Gynecologic oncology. 2013 Feb 1;128(2):300-8.
27. Ramachandran TS, Sinha R, Subramanium. Correlation between clinic pathological and ultrasonographic findings. Journal of Clinical Diagnosis and Research. 2011;5(4):734-40.
28. Huma Z, Naeem A, Shoaib M, Fayyaz S, Arjumand. A clinic pathological review of elective hysterectomies in Sir Ganga Ram hospital. Pak J Med Health Sci. 2012;6(4):970-2.
29. Jha R, Pant AD, Jha A, Adhikari RC, Syami G. The histopathological analysis of hysterectomy specimens. J Nepal Med Assoc. 2006;45(163):283- 90.
30. Rashid A, Qamar H, Pario S. Frequency and morphology of benign histopathological lesions in total abdominal hysterectomy specimens. The Professional Medical Journal. 2020 Mar 10;27(03):481-6.
31. Neelgund S, Hiremath P. Analytical study of hysterectomies. Int J Reprod Contracept Obstet Gynecol 2016; 5:2307-11.
32. Khaniki M, Shojaie M, Tarafdari AM. Histopathological study of hysterectomy operations in a University clinic in Tehran from 2005 to 2009. J Fam Reprod Health. 2011;5(2):51-5.
33. Shergill SK, Shergill HK, Gupta M, Kaur S. A clinic pathological study on hysterectomies. J Indian Med Assoc. 2002;100(4):238-9.
34. Bukar M, Audu B, Yahaya UR. Hysterectomy for benign gynaecological conditions at Gombe, North Eastern Nigerian. Nig Med J. 2010;35-8.
35. Gupta G, Kotasthane DS, Kotasthane VD. Hysterectomy: a clinico-pathological correlation of 500 cases. The Internet Journal of Gynaecology and Obstetrics. 2010;14(1):1-5.
36. Khan R, Sultana H. How does histopathology correlate with clinical and operative findings in abdominal hysterectomy? JAFMC Bangladesh. 2010;6(2):17-20
37. Neena Y, Honey B. Clinico-pathological correlation of hysterectomy specimens for abnormal uterine bleeding in rural area. J Evol Med Dent Sci. 2013;39(2):7506-12.
38. Jeffcoate's Principles of Gynaecology 7th internationaledition Kumar P, Narendra Malhotra; 2014:490.
39. Pathak V, Singh P, Tripathi A. Retrospective analytical study of total abdominal hyeterectomy for benign gynaecological conditions. Int J Reprod Contracept Obstet Gynecol 2017; 6:1596-603
40. Baral R, Sherpa P, Gautam D. Histopathological analysis of hysterectomy specimens: One year study. Journal of Pathology of Nepal 2017; 7:1084 -6.
41. Harshal A. Patil et al,. Histopathological findings in uterus and cervix of hysterectomy specimens. MVP Journal of Medical Sciences, 2015; 2(1):26–9.
42. Amin A, Ali , Amin Z, Sani FN. Justification for hysterectomies and frequency of histopathological lesions of hysterectomy at a Teaching Hospital in Peshawar, Pakistan. Pak J Med Sci 2013; 29(1):170-172. doi: http://dx.doi.org/10.12669/pjms.291.2509
43. Levgur M. Diagnosis of adenomyosis. A review. J Reprod Med 2007; 52:177.
44. A.Sobande et al,. Elective Hystrectomy: A clinicopathological review from Abha catchment area of Saudi Arabia. WAJM 2005; 24:31-35.
45. Ranabhat SK, Shrestha R, Tiwari M, Sinha DP, Subedee LR. A retrospective histopathological study of hysterectomy with or without salpingooophorectomy specimens. JCMC. 2010;1(1):26-9.
46. Isaoglu U. The evaluation of diagnosis in specimens of hysterectomy. Abant Med J. 2013; 2(2):941-943.
47. Ojeda VJ. The pathology of hysterectomy specimens.Z Med J. 1979; 89:169-71.
48. Veena BT, Shivalingaiah N. Role of transvaginal sonography and diagnostic hysteroscopy in abnormal uterine bleeding. J Clin Diagn Res. 2014;8(12):OC06–OC08. Doi: 10.7860/JCDR/2014/ 8813.5236
49. Bromley B, Shipp TD, Benacerraf B. Adenomyosis: sonographic findings and diagnostic accuracy. Journal of ultrasound in medicine. 2000 Aug;19(8):529-34.
50. Niknejadi M, Haghighi H, Ahmadi F, et al. Diagnostic accuracy of transvaginal sonography in the detection of uterine abnormalities in infertile women. Iran J Radiol. 2012;9(03):139–144. Doi: 10.5812/iranjradiol.8063
51. Siedler D, Laing FC, Jeffrey RB Jr, et al: Uterine adenomyosis: A difficult diagnosis. J Ultrasound Med 6:345, 1987
52. Reinhold C, Atri M, Mehio A, et al: Diffuse uterine adenomyosis: Morphologic criteria and diagnostic accuracy of endovaginal sonography. Radiology 197:609, 1995
53. Botsis D, Kassanos D, Antoniou G, et al: Adenomyoma and leiomyoma: Differential diagnosis with transvaginal sonography. J Clin Ultrasound 26:21, 1998
54. Brosens JJ, De Souza MN, Barker FG, et al: Endovaginal ultrasonography in the diagnosis of adenomyosis uteri: Identifying the predictive characteristics. Br J Obstet Gynaecol 102:474, 1995
55. Veena BT, Shivalingaiah N. Role of transvaginal sonography and diagnostic hysteroscopy in abnormal uterine bleeding. J Clin Diagn Res. 2014;8(12):OC06–OC08. Doi: 10.7860/JCDR/2014/ 8813.5236
56. Wanderley MD, Álvares MM, Vogt MF, Sazaki LM. Accuracy of transvaginal ultrasonography, hysteroscopy and uterine curettage in evaluating endometrial pathologies. Rev Bras Gineco
57. Niknejadi M, Haghighi H, Ahmadi F, et al. Diagnostic accuracy of transvaginal sonography in the detection of uterine abnormalities in infertile women. Iran J Radiol. 2012;9(03):139–144. Doi: 10.5812/iranjradiol.8063
58. Babacan A, Gun I, Kizilaslan C, et al. Comparison of transvaginal ultrasonography and hysteroscopy in the diagnosis of uterine pathologies. Int J Clin Exp Med. 2014;7(03):764–769