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TO CORRELATE AND ESTIMATE DIAGNOSTIC ACCURACY OF 3D ULTRASOUND IN UTERINE FIBROID MAPPING COMPARED TO INTRAOPERATIVE FINDINGS AS PER THE INTERNATIONAL FEDERATION OF GYNECOLOGY AND OBSTETRICS (FIGO) CLASSIFICATION

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Abstract:

Background: The process of describing the location, size, and character of uterine fibroids, commonly referred to as ‘fibroid mapping’. Mapping techniques helps surgeons plan efficient resection of the fibroid to optimize surgical outcomes. Hence this study was done to correlate and estimate the diagnostic accuracy of 3D ultrasound in fibroid mapping compared with intraoperative findings.

Methodology: A longitudinal study was done in a tertiary care hospital during March 2022 to September 2023 in all 50 patients posted for elective surgery. Complete 3D ultrasound assessment (both transabdominal and transvaginal) and mapping was performed by same radiologist for number of fibroids, size, location, type and FIGO class. Intraoperative findings were documented immediately after surgery. Spearman’s Correlation and diagnostic accuracy was estimated with $P<0.05$ considered as significant.

Results: The mean age and range of patients in this study includes 39±9.5 years and 15-48 years. Of 50 patients studied, the number of fibroids predicted by ultrasound matched with intraoperative findings in 42 patients which was 105 out of 117 (89.7%) fibroids. Strong positive correlation was seen with fibroid mapping with Spearman rho value of 0.89, 0.94 and 0.97 in subserosal, intramural and submucosal respectively. Diagnostic accuracy of subserosal, Intramural, Submucosal fibroids was 70.6%, 73.6% and 90.6% respectively.

Conclusion: Strong positive correlation was seen with fibroid mapping, done on ultrasound compared to intraoperative findings in 42 patients (84%) which was significant statistically. Also diagnostic accuracy of Subserosal, Intramural, Submucosal was 70.6%, 73.6% and 90.6% respectively.

Keywords: Uterine fibroid mapping, 3D ultrasound, intraoperative, correlation, sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy.

INTRODUCTION

Uterine fibroids (leiomyomas or myomas) are the most common neoplastic findings encountered in a symptomatic reproductive age women in sonography which often necessitates surgical intervention. [1,2] The International Federation of Gynecology and Obstetrics (FIGO) classification system is commonly used for classification of fibroids. [3]

FIGO Classification

Submucosal group

- type 0: pedunculated intracavitary
- type 1: <50% intramural
- type 2: ≥50% intramural

Other group

- type 3: 100% intramural; contacts endometrium
- type 4: intramural
- type 5: subserosal ≥50% intramural
- type 6: subserosal <50% intramural
- type 7: subserosal pedunculated
- type 8: other, e.g. cervical, parasitic

Hybrid leiomyoma group

- leiomyomas that impact both the endometrium and serosa
- two numbers listed separately separated by a hyphen with the first number indicating the endometrial relationship and the second number the serosal relationship. [4]

Figure 1: FIGO classification of uterine fibroid

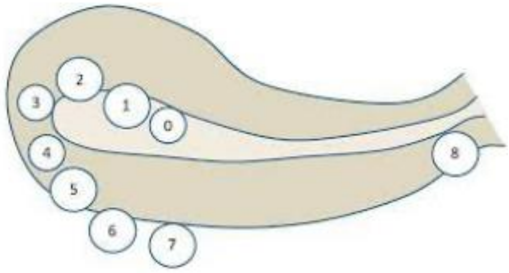


Image cited from: Wilde S, Scott-Barrett S. Radiological appearances of uterine fibroids. Indian J Radiol Imaging. 2009 Jul-Sep;19(3):222-31.

To be able to manage these fibroids, it is vital to understand their number, site, size and character. [5] The process of describing the location, size, and character of uterine fibroids, commonly referred to as 'fibroid mapping'. [6] Mapping techniques helps surgeons plan efficient resection of the pathology to optimize surgical outcomes.

Considering no radiation and easy availability ultrasound is the usual initial imaging modality preferred. Two-dimensional transvaginal ultrasound is adequate for the diagnosis of intramural fibroids; however, it can often be difficult to determine the exact location and number of fibroids present. [7]

Preoperatively, ultrasound can be used to map the location and size of uterine fibroids. These results assist in determining the best surgical approach. The use of 3D ultrasound will be emphasized as they are superior to 2D ultrasound.[8] Fibroid mapping using 3-D sonographic technique helps a surgeon to visualize fibroid location in multiplanar and volume rendered images, which are much more vivid than routine axial and longitudinal imaging. [9] It is also a useful tool for the investigation of myometrial pathology due to its ability to reconstruct the coronal plane of the uterus.[8,10]

This critical information allows for efficient intra-operative management and resection of fibroids reducing the risk of recurrence. Anticipating endometrial involvement may allow for resection without compromising the integrity of the endometrial cavity which could have a significant impact on fertility. Hence this study was done to correlate and estimate the diagnostic accuracy of 3D ultrasound in fibroid mapping compared with intraoperative findings.

Objectives:

1. To correlate 3D ultrasound findings with intra operative findings in uterine fibroid mapping based on FIGO classification.
2. To estimate diagnostic accuracy of 3D ultrasound in uterine fibroid mapping in comparison to intraoperative findings based on FIGO classification.

MATERIAL AND METHODS

A longitudinal study was done in a tertiary care hospital during March 2022 to September 2023 in all 50 patients posted for elective surgical management of uterine fibroids either laproscopic or transabdominal (includes fibroidectomy, hysterectomy or uterine artery embolization). Purposive sampling method was used. Institutional ethical clearance was obtained.

Inclusion criteria: Adult females diagnosed with symptomatic uterine fibroid, admitted for surgical management; who underwent preoperative 3D ultrasound uterine fibroid mapping and and willing to participate in the study after due written consent were included. Exclusion criteria includes pregnant women, > 60 years and who are not willing to participate in the study. ≥ 5 fibroids (as in the setting of 4 or more fibroids, MRI is likely superior to ultrasound for the purposes of preoperative planning. MRI is the appropriate modality). [11]

On admission data on history, clinical examination and investigations were recorded. Bladder and bowel complaints, mass per abdomen, duration of association with pain, rate of growth were recorded. Complete 3D ultrasound assessment (both transabdominal and transvaginal) and mapping was performed by same radiologist for number of fibroids, size, location, type and FIGO class. Instrument used for imaging was sonoscope 3D ultrasound. The convex transducer for 3D imaging with wide field of view and a central frequency of 3.5MHz – 6.5MHz. Sonography findings were summarized in a standard format by Palheta MS et al.[12] Intraoperative findings were documented immediately after surgery including number, size, and location of all fibroids removed and the same was correlated with preoperative 3D ultrasound findings. Also diagnostic accuracy of 3D ultrasound was assessed in comparison to intraoperative findings.

Data recorded were described as frequencies and percentages or mean and SD or median as applicable. Correlation between ultrasound and intraoperative findings was done using spearmans rho. Statistics like positive predictive value (PPV), negative predictive value (NPV), sensitivity, specificity, and accuracy were calculated. The level of significance (p-value) is considered as 0.05. Statistical software used was IBM SPSS version 22.0 (SPSS Inc, Chicago IL) and MEDCALC.

Definitions

- *Sensitivity*: probability that a test result will be positive when the disease is present (true positive rate).

  = ***a / (a+b)***

- *Specificity*: probability that a test result will be negative when the disease is not present (true negative rate).

  = ***d / (c+d)***

- *Positive predictive value*: probability that the disease is present when the test is positive.

$$PPV = \frac{sensitivity \times prevalence}{sensitivity \times prevalence + (1 - specificity) \times (1 - prevalence)}$$

- *Negative predictive value*: probability that the disease is not present when the test is negative.

$$NPV = \frac{specificity \times (1 - prevalence)}{(1 - sensitivity) \times prevalence + specificity \times (1 - prevalence)}$$

- *Accuracy*: overall probability that a patient is correctly classified.

  = ***Sensitivity* × *Prevalence* + *Specificity* × *(1 − Prevalence)***

Sensitivity, specificity, disease prevalence, positive and negative predictive value as well as accuracy are expressed as percentages.[13]

RESULTS

The mean age and range of patients in this study includes 39±9.5 years and 15-48 years. Most common clinical presentation was dysmenorrhoea (82%) and DUB (74%) followed by infertility (44%) and pressure symptoms (38%). Polycystic ovarian syndrome (44%) was the most common associated risk factor, other risk factors include obesity (40%) and thyroid disorders (24%). Myomectomy and hysterectomy was done in 74% and 22% patients. (table1)

Table 1: Distribution by characteristics of study participants

Characteristics		Descriptive statistics
Age in years (mean ±SD) and range		39±9.5 years 15-48 years
Main clinical presentation	Dysfunctional uterine bleeding (DUB)	37(74%)
	Dysmenorrhea	41(82%)
	Infertility/ recurrent miscarriage	22(44%)
	Pelvic pain /pressure symptoms	19 (38%)
Associated risk factors	Obesity	20 (40%)
	PCOS	22(44%)
	Thyroid disorders	12(24%)
Surgical management method	Myomectomy	37(74%)
	Uterine artery embolization	2 (4%)
	Hysterectomy	11(22%)

Of 50 patients studied, the number of fibroids predicted by ultrasound matched with intraoperative findings in 42 patients which was 105 out of 117 (89.7%) fibroids. As per FIGO classification, most common type of fibroid was type 2 and type 3. On ultrasound FIGO type 0,1,2,3,4,5 or more fibroids identified were 77.8%, 88.2%, 86.2%, 88%, 94.4% and 100% when compared with intraoperative findings. Submucosal, intramural and subserosal identified on ultrasound were 91.7%, 94.6% and 84.1% respectively. There was no significant difference in volume of fibroids on ultrasound assessment when compared to intraoperative assessment. Location of fibroid predicted by ultrasound matched with intraoperative findings in 95.8% anterior wall, 92.80% posterior wall, 94.1% right lateral wall, 100% left lateral wall and in 72.4% of fundal fibroids. (table2)

Table 2. Ultrasound versus intraoperative findings of uterine fibroids

Uterine Fibroid mapping	**Sub categories**	**Ultrasound finding (105)**	**Intraoperative finding (117)**	**Ultrasound versus intraoperative**
Median number of fibroid		2	2	1
Characterization as per FIGO	0	7	9	77.8%
	1	15	17	88.2%
	2	25	29	86.2%
	3	22	25	88%
	4	17	18	94.4%
	5 or more	19	19	100%
Number	Intramural	35	37	94.6%
	submucosal	33	36	91.7%
	subserosal	37	44	84.1%
Volume in ml (mean ±SD)	Intramural	125.1±107.7	124.06±103.3	P value: 0.349
	submucosal	115.24±89.7	112.9±90.7	P value: 0.516
	subserosal	113.5±96	115.7±100.2	P value: 0.738
	Total	118.7±102	119.6±99.8	P value: 0.81
Location	Anterior	23	24	95.8%
	Posterior	26	28	92.8%
	Right	16	17	94.1%
	Left	19	19	100%
	Fundus	21	29	72.4%

Strong positive correlation was seen with fibroid mapping, done on ultrasound with intraoperative findings in 42 patients (84%) which was significant statistically. Spearman rho value was 0.89, 0.94 and 0.97 in subserosal, intramural and submucosal respectively. (table3)

Table3: Correlation of 3D ultrasound findings of fibroid mapping with intraoperative findings

Fibroid type	**N**	**Spearman rho**	**P Value**
Subserosal	37	0.89	<0.05

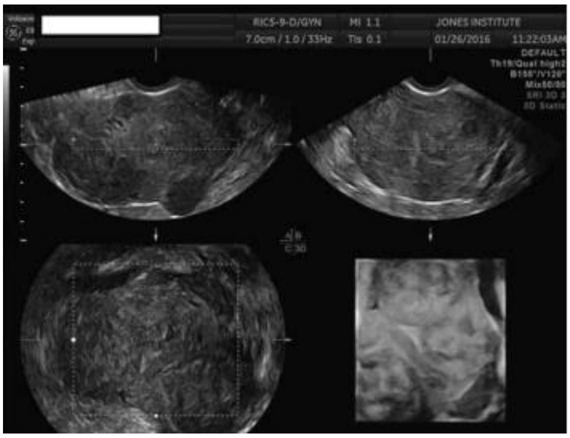
Intramural	35	0.94	<0.05
Submucosal	33	0.97	<0.05

Sensitivity of ultrasound findings over intraoperative findings of Subserosal, Intramural, Submucosal fibroid was 92.3%, 88.64%, 93.55% and specificity was 76.5%,55.2%, 82.1% respectively. Also Diagnostic accuracy of Subserosal, Intramural, Submucosal was 70.6%, 73.6% and 90.6% respectively. (table4)

Table 4: Diagnostic statistic of Ultrasound finding compared to intraoperative findings

3D US compared to intraoperative findings	**Subserosal**	**Intramural**	**Submucosal**
Sensitivity (95 CI)	92.3% (74.9%-99%)	88.64% (75.4%-96.2%)	93.55% (78.6%-99.2%)
Specificity (95 CI)	76.5% (53.4%-89.7%)	55.2% (32.7%-79.8%)	82.1% (67.9%-97.5%)0.85-1.03
Positive predictive value (95 CI)	75% (72.9%-77%)	81.2% (79.6%-82.8%)	93.4% (83.78%-99.9%)
Negative predictive value (95 CI)	84.2% (67%-87%)	85.1% (79.1%-89.7%)	83.7% (76.2%-92.1%)
Diagnostic accuracy (95 CI)	70.6% (52.5% - 84.9%)	73.6% (56.7% - 84.7%)	90.6% (75%-98%)

Figure 2: Preoperative 3D ultrasound of intramural fibroids



DISCUSSION

Uterine fibroid mapping when done preoperatively enhances fibroid detection and improves surgical outcomes.[14] Hence advanced imaging techniques to be assessed for their abilities.

In this study the mean age and range of patients was 39±9.5 years and 15-48 years. Most common clinical presentation was dysmenorrhoea (82%) and DUB (74%) followed by infertility (44%) and pressure symptoms (38%). Similarly in study by Patel H H et al, the mean age of study participants was 40.5 years old (range 21–62). The most common indication for surgical intervention was abnormal uterine bleeding (61%) and pelvic pain/bulk symptoms (61%) followed by infertility (15%).[15] In study done by Rajeshwari et al in Mumbai has reported incidence of menorrhagia and metrorrhagia in 78% and 10% of patients respectively.[16] Similarly, study done by Shagufta et al in Pakistani women from Peshawar, incidence of menorrhagia was 78.99% and 75% of them presented with both anemia and menorrhagia.[17]

In this study median number of fibroid per patient was 2 with average volume 118.7±102 on ultrasound and 119.6±99.8 intraoperatively which no significant difference. In study by Battista C et al, the average number of myomas recorded in the ultrasound was slightly more with mean number 2.87 ± 1.97 (mean ± standard deviation) and with a mean uterine volume of 319 ± 216 ml. [18]

In the current study location of fibroid predicted by ultrasound matched with intraoperative findings in 95.8% anterior wall 23/105 i.e 21.9% and 26/105 i.e 24.8%. In study by Ngorili GS location of fibroid on USG was anterior in 58.5% cases and posterior in 29.5% cases.[19]

In the present study sensitivity of ultrasound findings over intraoperative findings of Subserosal, Intramural, Submucosal fibroid was 92.3%, 88.64%, 93.55% and specificity was 76.5%,55.2%, 82.1% respectively. Also Diagnostic accuracy of Subserosal, Intramural, Submucosal was 70.6%, 73.6% and 90.6% respectively. In study by Pereira et al, When evaluating the diagnosis of fibroids, identified an accuracy level of 87.9%, but this was associated with very low sensitivity, specificity.[20]

Thus 3D Ultrasound has no significant difference when compared to intraoperative findings and can be used as an imaging modality when the number of fibroids were less than 5 where MRI is preferred.

CONCLUSION

Strong positive correlation was seen with fibroid mapping, done on ultrasound compared to intraoperative findings in 42 patients (84%) which was significant statistically. Spearman rho value was 0.89, 0.94 and 0.97 in subserosal, intramural and submucosal respectively. Sensitivity of ultrasound findings over intraoperative findings of Subserosal, Intramural, Submucosal fibroid was 92.3%, 88.64%, 93.55% and specificity was 76.5%,55.2%, 82.1% respectively. Also Diagnostic accuracy of Subserosal, Intramural, Submucosal was 70.6%, 73.6% and 90.6% respectively.

Limitations: single centered study. Limited to patients with number of fibroids less than 5.

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