

Role of Uterine Artery Doppler in Subfertile Females.

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Abstract

Background: Multiple causes of female subfertility have been described in the medical literature including the morphological and various pathological conditions of uterus & ovaries. The less commonly documented and evaluated causes include uterine and ovarian perfusion. With modern ultrasound scanners, it is now possible to perform and couple color doppler studies of uterine & ovarian arteries with routine Endovaginal Sonography. Various doppler indices including RI, PI and S/D ratio can provide insight into the status of uterine perfusion which is linked to uterine receptivity for implanting zygote. Hence, we conducted a pilot study to evaluate the role of uterine artery doppler for assessing uterine perfusion in subfertile females.

Materials/Methods: Twenty subfertile and ten fertile females in 20-30years age-group formed our study population with strict adherence to inclusion & exclusion criteria. All the included females underwent color doppler study of the uterine arteries with recording of RI & PI values along with SD ratio. Sensitivity, specificity and accuracy of above doppler indices was then calculated.

Results: Using the cut-off RI value of 0.9, our study revealed a sensitivity, specificity and accuracy of 85%, 80% and 83.3% respectively. However, using the cut-off PI value of 3.0, our study revealed a sensitivity, specificity and accuracy of 95%, 90% and 93.3% respectively while using the cut-off SD ratio of 5.0, our study revealed a sensitivity, specificity and accuracy of 90% each.

Conclusions: Uterine artery doppler indices are altered in subfertile females and are significantly higher than those in fertile females. Among high RI, high PI and high SD ratio, high PI values are strong indicators of poor uterine perfusion. As doppler indices provide objectivity to evaluation of uterine perfusion in subfertile females, they should be used routinely in their evaluation in addition to the follow up of these patients on various drugs aimed at improving the uterine receptivity.

Keywords: Uterine artery, Doppler, subfertile, females

Introduction

In this modern era, many women of reproductive age group are unable to conceive in natural course due to variety of causes. Besides the various morphological & pathological uterine & ovarian causes, many subfertile females have altered uterine perfusion which affects the uterine receptivity for implantation of zygote [1].

Endovaginal ultrasonography (EVS) is usually the first line investigation in such patients that can be coupled with

colour Doppler and 3D/4D scans [2]. EVS with 3D/4D helps in determining the morphology of uterus/ovaries & endometrial thickness while color doppler assesses the uterine/ovarian perfusion & endometrial vascularity [2]. The various indices used in doppler studies include resistive index (RI), pulsatility index (PI) and systolic-diastolic ratio (SD ratio). In subfertile patients, high RI & PI values have been described in medical literature [3].

Many studies in the Western Medical literature have suggested that successful outcome in subfertile females can be achieved by increasing uterine receptivity which is directly related to decreased vascular resistance and increased vascular flow [4]. In fact, increased vascular resistance in uterine artery during mid-luteal phase has also been described as an independent indicator of future pregnancy loss [5].

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Hence, we conducted a pilot study to evaluate uterine artery doppler indices in subfertile females in our institution.

Aims & Objectives

- To evaluate uterine artery doppler indices in subfertile females.
- To compare the uterine artery doppler indices in fertile and subfertile females.
- To determine the statistical significance of uterine artery doppler indices in subfertile females.

Materials and Methods

This hospital-based, comparative, case-control study was performed on twenty subfertile female patients and ten fertile females of 20-30 year age group with former constituting the cases & latter, the control group.

All cases and controls underwent EVS coupled with colour Doppler study during the ovulatory phase of menstrual cycle i.e. 48 hours prior and after the expected day of ovulation which should correspond to the maximal uterine perfusion. Resistive Index (RI), Pulsatility Index (PI) and systolic-diastolic ratio (SD ratio) were recorded in each case & control with subsequent statistical analysis using appropriate tools.

Inclusion Criteria

- All clinically fertile females of 20-30 years of age (delivered a live baby in last two years, with delivery more than 06 months back).
- All clinically subfertile females of 20-30 years of age (unable to conceive for more than 12 months with unprotected intercourse).

Exclusion Criteria

Sonographic evidence of congenital uterine malformation; adenomyosis; uterine masses (like Fibroids); infections (like endometritis); inflammatory disease (like endometriosis) and pelvic congestion syndrome as these factors may alter uterine perfusion.

Observations (Images 1 & 2)

Our study included 10 fertile and 20 subfertile females. Among subfertile females, *five* had primary and *fifteen* had secondary infertility.

Table 1 shows that 8/10 fertile females had RI value less than 0.9 while Table 2 shows that 17/20 subfertile females had RI equal to or greater than 0.9.

Table 1: Distribution of patients based on RI values in fertile group

	RI value <0.9	RI value >0.9
No. of Patients	8	2

Table 2: Distribution of patients based on RI values in subfertile group

	RI value <0.9	RI value >0.9
No. of Patients	3	17

Table 3 shows that 9/10 fertile females had PI value less than 3.0 while Table 4 shows that 19/20 subfertile females had PI equal to or greater than 3.0.

Table 3: Distribution of patients based on PI values in fertile group

	PI value <3.0	PI value >3.0
No. of Patients	9	1

Table 4: Distribution of patients based on PI values in subfertile group

	PI value <3.0	PI value >3.0
No. of Patients	1	19

Table 5 shows that 9/10 fertile females had SD ratio less than 5.0 while Table 6 shows that 18/20 subfertile females had SD ratio equal to or greater than 5.0.

Table 5: Distribution of patients based on SD ratio in fertile group

	SD ratio <5.0	SD ratio >5.0
No. of Patients	9	1

Table 6: Distribution of patients based on S/D ratio in subfertile group

	SD ratio <5.0	S/D ratio >5.0
No. of Patients	2	18

Results & Analysis

High RI value is a marker of reduced uterine perfusion in subfertility. Table 7 shows various statistical values obtained using RI>0.9 as cut-off value for reduced uterine perfusion.

Table 7: Statistical values based on RI>0.9

SENSITIVITY	SPECIFICITY	ACCURACY
85%	80%	83.3%

Like high RI value, high PI value is also a marker of reduced uterine perfusion in subfertility. Table 8 shows various

statistical values obtained using $PI > 3.0$ as cut-off value for reduced uterine perfusion.

Table 8: Statistical values based on $PI > 3.0$

SENSITIVITY	SPECIFICITY	ACCURACY
95%	90%	93.3%

Like high RI & PI values, high SD ratio is also a marker of reduced uterine perfusion in subfertility as low SD ratio indicates higher proportion of diastolic flow. Table 9 shows various statistical values obtained using SD ratio > 5.0 as cut-off value for reduced uterine perfusion.

Table 9: Statistical values based on SD ratio > 5.0

SENSITIVITY	SPECIFICITY	ACCURACY
90%	90%	90%

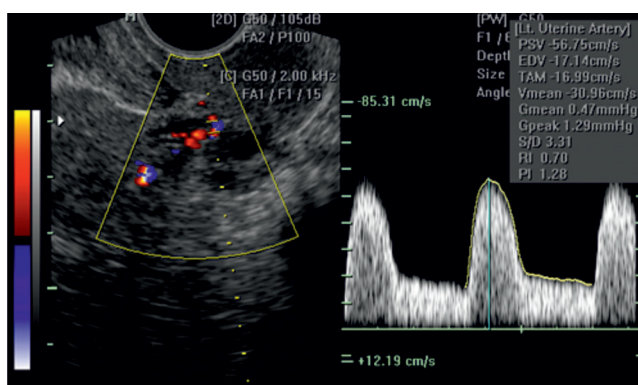


Image 1: Spectral Doppler in Fertile Female

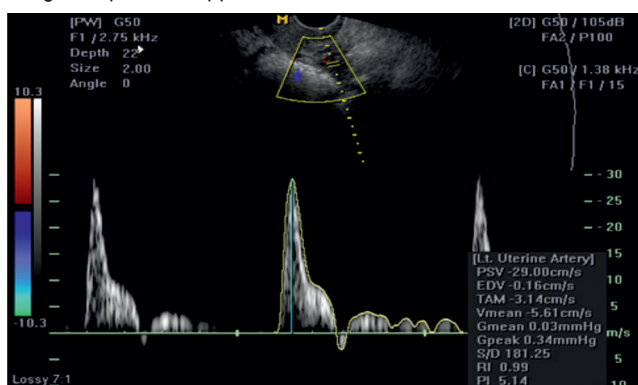


Image 2: Spectral Doppler in Subfertile Female with reverse diastolic component

Discussion

Uterine perfusion is one of the important factors affecting the fertility of female in reproductive age group as it is related to high probability of implantation of a blastocyst [1,4]. It can be objectively studied only by evaluating uterine artery Doppler indices and endometrial flow [3-5]. The Doppler indices that can be used as objective markers of uterine perfusion include RI value, PI value and SD ratio. Optimal uterine perfusion is considered only when RI, PI

and SD ratio in both uterine arteries are within normal limits.

In the present study, we have tried to objectively assess the uterine artery Doppler indices in subfertile patients using cut-off values and compared these values with those in clinically fertile patients of similar age group. In our study, we observed that among the three Doppler indices of uterine perfusion, PI values has got the maximum sensitivity, specificity and accuracy followed by SD ratio with RI value being least sensitive, specific and accurate.

In a study by Dickey, PI value of 3.3-3.5 and RI value of 0.95 was associated with significant reduction in pregnancy rate [6]. In the study by Friedler S, et al, the reported sensitivity & specificity of 96-100% & 13-35% respectively using higher PI value for detecting reduced uterine perfusion in subfertile females were higher and lower respectively than that obtained in our study [7].

In a study by Khan MS, et al, no pregnancy occurred in patients with PI value of more than 2.8 [8]. Prasad S, et al obtained a sensitivity of 92.75% using cut-off $RI < 0.9$ which is higher than that obtained in our study [9]. However, the sensitivity and specificity obtained in their study by using cut off $PI < 2.05$ and SD ratio < 4.2 were significantly lower than that obtained in our study using higher cut-off values of PI & SD ratio [9]. Hashad AMNE et al also reported that uterine perfusion based on RI & PI values are significantly different in subfertile patient than those in fertile females [10].

Based on our study results, we postulate the role of uterine artery doppler indices in objective assessment of the role of various pharmacological agents targeted to improve uterine perfusion in an attempt to improve fertility. However, a study with larger number of patients is needed to extrapolate our results on a larger subfertile population.

Limitations

- Small sample size of both fertile and subfertile group.
- Limited age group of 20-30 years is included.
- The effect of other factors on uterine perfusion has not been studied as they are included in exclusion criteria.

Summary

Uterine perfusion is an important factor determining the uterine receptivity to implanting blastocyst. This uterine perfusion may be altered in subfertile females. RI, PI and SD ratio of uterine artery are useful objective indicators of uterine perfusion. Higher RI & PI values along with high SD ratio is useful in predicting reduced uterine perfusion in subfertile females with a considerable degree of sensitivity, specificity and accuracy, hence should be used routinely to

improve the management outcome.

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