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Original Research Paper

Gynecology

ULTRASONIC EXAMINATIONS OF THE ENDOMETRIUM AND SERUM ESTRADIOL/PROGESTERONE RATIO AS PREDICTORS OF PREGNANCY RATE AFTER ICSI/ET CYCLES

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ABSTRACT **Objective:** To determine whether or not endometrial thickness, echogenic pattern and E2/P ratio measured on the day of embryo transfer can serve as reliable predictors of treatment outcome following ICSI/ET cycles. **Methods:** A total of 367 infertile women undergoing embryo transfer after ICSI cycles were studied in a prospective study. Ultrasound measurement of endometrial thickness on the day of hCG administration and on the day of ET and E2/P ratio on the day of embryo transfer, hormonal profile (Day 3 FSH, LH and E2), and various other variables (age, BMI, number of oocytes retrieved per patient, fertilization rate, number and quality of embryos) were evaluated. These variables were compared among the clinical pregnancy, chemical pregnancy and non-pregnant groups. Also, their influence on implantation rate was examined. **Results:** There was no statistically significant difference in the measured endometrial thickness on the day of hCG administration (10.67 ± 2.25, 10.59 ± 2.18, 10.56 ± 2.22, P = 0.5) and that measured on the day of embryo transfer among the three groups. The distribution of patients with type A endometrium among the clinical pregnancy Vs the chemical pregnancy group (p=0.9) and that among the clinical pregnancy group Vs the non-pregnant group (p=0.14) was statistically insignificant. The E2/P ratio was calculated and compared among the three groups, however the difference was statistically insignificant (78.08 ± 85.27, 51.86 ± 44.81, 110.57 ± 274.49, p=0.65). **Conclusion:** Ultrasonographic features of the endometrium (thickness and echo-pattern) and E2/P ratio cannot be used as reliable markers for endometrial receptivity in the clinical setting.

KEYWORDS : Endometrial thickness, echo-pattern, Estradiol, Progesterone, endometrial receptivity.

INTRODUCTION

The first successful birth of a "test tube baby", Louise Brown, occurred in 1978. Louise Brown was born as a result of natural cycle IVF where no stimulation was made. Robert G. Edwards was awarded the Nobel Prize in Physiology or Medicine in 2010, the physiologist who co-developed the treatment together with Patrick Steptoe; Steptoe was not eligible for consideration as the Nobel Prize is not awarded posthumously ***(Moreton et al., 2007).***

The success of IVF cycles is mainly dependent on age, quality of the embryo and endometrial receptivity ***(Wu et al., 2014).***

Several sonographic parameters have been developed in the identification of endometrial receptivity, including endometrial thickness, endometrial pattern, endometrial volume and endometrial and subendometrial blood flow ***(Wang et al., 2010)*** among which endometrial thickness and endometrial pattern have been widely accepted as prognostic indications for endometrial receptivity.

While histological changes can only be examined by biopsy, transvaginal ultrasound is a non invasive, easy and reliable method to measure endometrial parameters like thickness and pattern ***(Makker and Singh, 2006).***

Endometrial thickness is commonly measured in the midsagittal plane, from the outer edge of the endometrial – myometrial junction to the outer edge of the thickest part of the endometrium by two – dimensional ultrasonography ***(Chen et al., 2010).***

Two distinct endometrial patterns have been defined, one of "homogenous" echogenicity and one of a "multi-layered" or triple – line" echogenicity, ***(Singh et al., 2011).***

Both progesterone (P) and estradiol (E2) are essential for the endometrial preparation in order to be able to harbor the coming blastocyst. Controlled ovarian hyperstimulation used during ICSI cycles leads to abnormally high serum levels of E2 and P secondary to excessive follicular growth ***(Gruber et al., 2007).*** Such an imbalance can adversely affect the luteal phase and the implantation rates in ICSI cycles ***(Albano et al., 1998).***

AIM OF THE WORK

The aim of this work is to:

- Clinically review and evaluate the comprehensive use of endometrial thickness, endometrial pattern & serum E2/P ratio in the prediction of embryo implantation after ICSI by correlating to chemical pregnancy rate, clinical pregnancy rate and implantation rate.
- Analyse the relationship between the treatment outcome (clinical pregnancy) and patient's age, BMI, day 3 FSH, day 3 LH, day 3 E2, number of oocytes retrieved, fertilization rate, number and quality of embryos transferred.

SUBJECTS

This was a prospective observational study of 390 patients with 1ry or 2ry infertility.This study was conducted in jointly between Benha Teaching Hospital and the Jasmine Center for ICSI Benha-city-Egypt, during the period from January 2016 to the end of January 2020.

Patient selection and inclusion criteria:

1. Patients who were less than 40 years old.
2. BMI ranging between 19 and 34.
3. Patients with good ovarian reserve.

Exclusion criteria:

1. Patients who aged above 40 years.
2. Patients with uterine factor of infertility eg. (septate uterus or suspected or treated uterine polypi).
3. Patients with a communicating hydrosalpinx.
4. Patients who missed there agonist doses and had to be shifter to antagonist protocol.
5. Expected to be poor responders (AMH less than 1ng/dl).
6. Patients whose ICSI cycle entailed testicular biopsy or aspiration (severe male factor and azoospermia).
7. Patients with a medical or surgical conditions contraindicating pregnancy.

Methods:
If the patients fitted the inclusion criteria and were not excluded, they either started a long or short agonist protocol if no significant risk of OHSS was detected or a short antagonist protocol if OHSS risk was high.

The standard ovarian stimulation long protocol was performed by providing GnRH agonists (leuprolide acetate 0.1 mg) daily by subcutaneous route for 7-14 days until down regulation is achieved starting from day 21 or 22 of the cycle.

Down regulation was documented by E2 level less than 50 pg/ml and/or endometrial thickness less than 5mm.

Once ovarian down regulation was achieved daily IM HMG preparation (Merional 75 IU FSH-75 IU LH ® IBSA) was titrated according to ovarian response.

As for short protocol, the initial flare is achieved by providing GnRH agonists (leuprolide acetate 0.1 mg) daily by subcutaneous route, starting on the 2nd day of the cycle continuing till the day of hCG injection. On day 3, daily IM HMG preparation (Merional 75 IU FSH-75 IU LH ® IBSA) was started and titrated according to ovarian response.

As for antagonist protocol, administration of IM HMG preparation (Merional 75 IU FSH-75 IU LH ® IBSA) is initiated after monitoring of patients' follicles sizes on cycle-day 2/3. Gonadotropin dosage varies according to the follicular response. Approximately after the 6th days of gonadotropin injection or when follicular size reaches more than or equal to 14 mm, subcutaneous administration of the GnRH antagonist (Cetrotide 0.25 mg) begins.

Ovarian response was assessed by ultrasound till at least three leading follicles reach 18 mm in diameter. Final oocyte maturation was triggered by 10000 unit of HCG (Choriomon 5000 ®, IBSA) & oocytes retrieved 36 hours later. The luteal phase support included daily intramuscular injection of 100 mg of progesterone along with vaginal supplementation of 400 mg of progesterone (PRONTOGEST ®) starting on the day of oocyte retrieval.

Oocytes inseminated by intra-cytoplasmic sperm injection (ICSI). Embryos were cultured in vitro, embryos were transferred under transabdominal U/S guidance 3 or 5 days after oocyte retrieval and fertilization.

Embryos were classified as follows:
Grade 1: Perfectly symmetrical with no fragmentation.
Grade 2: Perfectly symmetrical with slight fragmentation (< 20% fragmentation of the total embryonic volume).
Grade 3: Uneven blastomeres with no fragmentation.
Grade 4: Uneven blastomeres with gross fragmentation (> 20% fragments).

Embryos of grade 1 or 2 are considered high quality ***(Veeck, 1999).*** Endometrial thickness was measured by transvaginal U/S on trigger day, and by transabdominal U/S at ET. The endometrial pattern was assessed according to the classification proposed by Oliveria et al. ***(Oliveria et al., 1997)*** as follows:

1. Type A: an endometrium with a trilaminar pattern identified as a prominent outer and hypoechoic layer with a central hyperechoic line (figure 1).
2. Type B: an endometrium that is entirely homogenously hyperechoic without a central echogenic line or including the iso-echogenic pattern (figure 1).

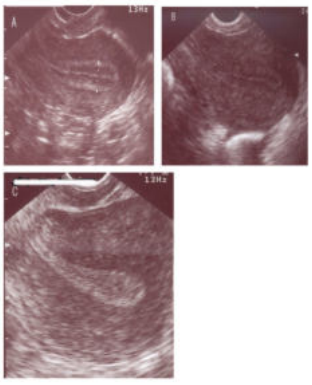

Figure (1)
Venous samples were collected on the day of embryo transfer, serum E2& P were estimated and E2/P ratio was calculated.

Serum β-hCG was measured 14 days after ET to diagnose pregnancy. Transvaginal U/S examination was performed at 6 weeks gestation to demonstrate and confirm an intrauterine pregnancy.

Outcome measures:
Primary outcomes were correlating endometrial thickness, echogenic pattern and E2/P ratio to chemical pregnancy rate, clinical pregnancy rate and implantation rate.

Chemical pregnancy was defined as conception established only on biochemical serum data.

Clinical pregnancy was defined as visualization of intrauterine gestation with cardiac action whereas implantation rate was calculated by dividing the number of gestational sacs visualized on transvaginal ultrasound by the number of embryos transferred.

Secondary measures:
Secondary outcomes were assessing the relationship between the treatment outcome (clinical pregnancy) and patient's age, BMI, day 3 FSH, day 3 LH, day 3 E2, number of oocytes retrieved, fertilization rate, number and quality of embryos transferred.

Fertilization rate was defined as the proportion of oocytes resulting in two pronuclei formation; only metaphase II oocytes were counted in the ICSI/ET cycles.

Statistical Methods:
IBM Statistic Package for Social Sciences (SPSS v 20.0 for Windows, Chicago, IL) software was used for data analysis. Description of quantitative variables was done as mean, S.D and range. Description of qualitative variables was done as numbers and percentage. Unpaired t-test was used to compare two independent groups as regard a quantitative variable. Values in the three groups were compared using the nonparametric Kruskal-Wallis test.

While comparing values among the group with implantation rate <50% and that with implantation rate ≥ 50% the Chi-squared test was used. Significance was interpreted as $p < 0.05$.

RESULTS

We approached 390 patients and data was collected as shown in Figure (2).

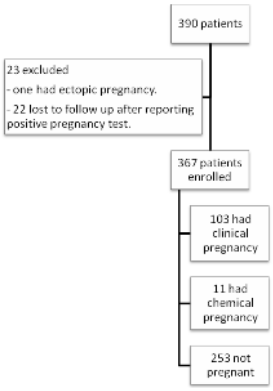

Figure (2): Consort flow diagram of the study group.

The pregnancy rate was the primary calculation; it was 35.13% (137/390). From those 23 cases were excluded due to: one case had ectopic pregnancy and 22 cases lost to follow up after reporting positive pregnancy test. Only 367 patients were enrolled in the study. Amongst those, 28.06% (n=103) had clinical pregnancy, 2.99% (n=11) had chemical pregnancy and 68.94% did not conceive (n=253). ***(Figure 2).***

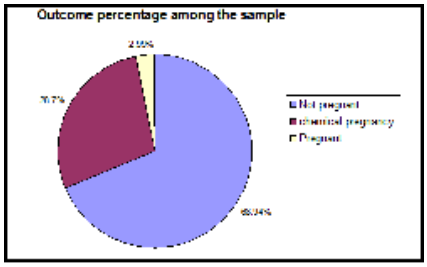

Figure (3): Pie chart showing proportion of pregnancy (clinical & chemical) and failure of pregnancy among the study population.

A total number of 367 cases were enrolled, amongst those, 28.7% (n = 103) had clinical pregnancy, 2.99% (n = 11) had chemical pregnancy and 68.94% (n= 253) did not conceive. ***(Figure 3).***

Table (I): Demographic data of the studied infertile women.

	Clinical pregnancy group (n=103)	Chemical pregnancy group (n=11)	Non pregnant group (n=253)	P value
Age (y)	29.1±5.07	28.36±6.77	28.93±5.3	0.88
BMI	29.49±3.6	28.7±4.21	27.73±4.36	0.14
D3 FSH (IU/L)	6.21±1.74	6.1±2.06	6.63±2.16	0.17
D3 LH (IU/L)	4.97±2.3	4.81±1.64	5.48±3.04	0.63
D3 E2 (pg/ml)	47.15±24.09	64.05±27.9	53±47.54	0.04
Days of stimulation	11.5±2.21	12±1.41	11.04±2.1	0.12
Dose of gonadotrophins (ampoules)	40.69±12.47	40.64±8.63	38.01±11.91	0.44

There were no statistically significant difference, as regards, age, BMI, day 3 FSH, LH, days of stimulation, and doses of gonadutrophius.

Only serum day 3 E2 was high in group of chemical pregnancies (P < 0.04). Table (II): Summary of the results of the secondary outcome.

	Clinical pregnancy group (n=103)	Chemical pregnancy group (n=11)	Non pregnant group (n=253)	P value
No of oocytes/patient	9.84±5.3	12.73±4.84	9.72±5.2	0.14
Fertilization rate	83.83±16.01	82.63±14.89	81.56±17.3	0.56
No of embryos transferred / patient	3.38±0.82	3.09±0.94	3.02±0.89	0.0047
Embryo quality Group 1* Group 2**	100% Zero%	100% Zero%	98.02% 1.98% (n=5)	0.15***

* Group 1: at least one high quality embryo transferred.
** Group 2: No high quality embryo transferred.
*** Clinical pregnancy vs non-pregnant group.

The difference in the average number of oocytes retrieved per patient in each group (9.84 ± 5.3, 12.73 ± 4.84, 9.72 ± 5.2, p=0.14), the fertilization rate (83.83 ± 16.01, 82.63 ± 14.89, 81.56 ± 17.3, p=0.56) was statistically insignificant, when comparing the embryo quality amongst the 3 groups each group was further subdivided into 2 groups; group one had at least one good quality embryo transferred (G1 & G2), while group two did not fulfill this criterion and had either G3 or G4 embryos transferred, in both the clinical and chemical pregnancy groups, 100% of patients received at least one high quality embryo, while in the non-pregnant group, 5 patients did not receive high quality embryos. However, this was not statistically significant (p=0.15).

The number of embryos transferred per patient was higher in the clinical pregnancy group 3.38±0.82, while it was 3.09±0.94 in the chemical group and 3.02±0.89 in the non-pregnant group. which was statistically significant (p=0.0047).

Table (III): Comparison between endometrial thickness and echo-pattern among the clinical, chemical and non-pregnancy groups.

Variable	Clinical pregnancy group (n=103)	Chemical pregnancy group (n=11)	Non pregnant group (n=253)	P value
Endometrial thickness ^{trigger} (mm)	10.67 ± 2.25	10.59 ± 2.18	10.56 ± 2.22	0.5
Endometrial thickness ^{transfer} (mm)	10.48 ± 1.95	10.35 ± 2.35	10.18 ± 2.42	0.13
Endometrial echogenic pattern	80.58 (n=83)	81.82 (n=9)	73.12 (n=185)	0.9* 0.14**
Type A (%)	19.42 (n=20)	18.18 (n=2)	26.88 (n=68)	
Type B (%)				

Data are presented as mean ± SD apart from echogenic pattern (EP) which is presented in percentage.

* Clinical pregnancy group vs chemical pregnancy group.
** Clinical pregnancy group vs non-pregnant group.

Endometrial thickness measured on the day of HCG administration was (10.67 ± 2.25, 10.59 ± 2.18, 10.56 ± 2.22 mm, p = 0.5) and that measured on the day of embryo transfer (10.48 ± 1.95, 10.35 ± 2.35, 10.18 ± 2.42 mm, p = 0.13) which was not statistically significant among the three groups.

The difference in the proportion of patients with type A endometrium among the clinical pregnancy vs the chemical pregnancy group (p=0.9) and that among the clinical pregnancy group vs the non-pregnant group (p=0.14) was

statistically insignificant.

Table (IV):Comparison showes relations between E2, Progesterone and E2/P ratio among the clinical, chemical and non-pregnancy groups.

Variable	Clinical pregnancy group (n = 103)	Chemical pregnancy group (n =11)	Non pregnant group (n=253)	P value
$E2^{transfer}$ (pg/mL)	2515.09±1459.8	2069.73±884.15	2665.53±2247.13	0.46
Progesterone ^{transfer} (ng/mL)	75.14 ± 73.13	83.54 ± 78.6	69.52±69.41	0.54
E2/P ratio	78.08±85.27	51.86±44.81	110.57±274.49	0.65

Data are presented as mean ± SD.

There was no statistically singificant difference between E/P ratios among the three groups (78.08 85.27, 51.86 44.81, 110.57 274.49, P = 0.65) Table (IV).

Table (V): Comparison of parameters among the group with less than 50% and that with greater than or equal to 50% implantation rate:

Variable	Clinical Pregnancy group (n = 103)		P value
	Implantation Rate<50% (n=58)	Implantation Rate≥50% (n=45)	
$ET^{trigger}$ (mm)	10.94±2.58	10.32±1.71	0.17
ET transfer (mm)	10.48±2.02	10.49±1.87	0.98
EP ^{trigger} Type A (%) Type B (%)	70.69(n=41) 29.3 (n=17)	93.33(n=42) 6.67 (n=3)	0.004
$E2^{transfer}$ (pg/mL)	2723.81±1587.72	2246.07±1242.19	0.099
Progesterone ^{transfer} (ng/mL)	77.37±76.17	72.27±69.76	0.73
E2/P ratio	85.76±100	68.19±61	0.3

Data are presented as mean ± SD apart from echogenic pattern (EP) which is presented in percentage.
ET : Endometrial thickness
EP: Endometrial pattern.
Regarding the implantation rate, the clinical pregnancy group was further subdivided into 2 subgroups; less than and greater than or equal 50%: ***(Table V)***

The difference in the endometrial thickness measured on trigger day (10.94±2.58, 10.32±1.71, p=0.17), that measured on transfer day (10.48±2.02, 10.49±1.87, p=0.98), E2/P ratio (85.76±100, 68.19±61, p=0.3) among the two groups was not statistically significant.

Results revealed that as the proportion of patients with type A echopattern incresed, the implantation rate incresed which was statistically significant (p=0.004).

DISCUSSION

Many authors have tried to identify a simple method to evaluate the quality of the uterine lining. The overall consensus is that transvaginal ultrasound scan fits the criteria the best, the crucial questions are: what parameters can be obtained through grey-scle ultrasound of the endometrium? and are the ascertained parameters suitable for predicting treatment outcome ***(Diedrich et al., 2012).***

Successful implantation is attributed to availability of top quality embryos and receptive endometrium endorsed to optimal levels of hormones precisely E2 and P ***(Ganesh et al., 2009).***

E2/P ratio is thus a supposed marker for endometrial receptivity which up regulates adhesion molecules on the endometrial pinopads and equivalent ligands on the blastocyst for successful implantation, ***(Abuelghar et al., 2013).***

Several studies proposed poor results associated with thin endometrium, for example a study by ***Mahajan and Sharma (2016)*** concluded that even though pregnancies have been reported at 4 and 5 mm. It is apparent that an endometrial thickness <6mm is associated with a tendency towards lower pregnancy rate. We were not able to evaluate such an effect as our mean endometrial thickness was 10.67 mm for the pregnant group, 10.59mm for the chemical pregnancy group and 10.56 mm for the non-pregnant group which was higher than the mentioned value.

In our study no significant correlation was found between endometrial thickness measured on the day of hCG administration or the day of ET and pregnancy rate nor implantation rate. Perhaps this can be attributed to a large sample size over a longer duration. Several studies however, agree with our findings. and there were several reports of successful pregnancies resulting from cycles with endometrial linings of ≤ 4 mm, indicating that even an exceptionally thin endometrium does not necessarily relinquish the possibility of implantation ***(Check et al., 2003).***

The relatively high success rate observed among patients with very poor endometrial development in the study by ***Dungan (2008)*** that evaluated the relationship between endometrial thickness and clinical outcome of IVF and fresh autologous ET of two blastocyst-stage embryos, including at least one good-quality blastocyst and endometrial thickness was greater in cycles resulting in pregnancy than in cycles not resulting in pregnancy (11.9 vs. 11.3 mm, respectively), clinical pregnancy rates increased gradually from 53% among patients with a lining of <9 mm, to 77% among patients with a lining of > or =16 mm suggests that cancellation of ET based on a thin endometrial lining is unwarranted. Yet, without doubt one can conclude with the adage that the thicker the endometrium the better the chance of pregnancy. It is not a yes or no answer, it is rather a higher or lower chance with thicker endometrium. Perhaps this should be grounds for further research and could be implemented in patients' counseling.

Zhao et al (2016) conducted a retrospective study of 3319 women to assess predictive ability of endometrial characteristics for outcomes of IVF / ET. Endometrial thickness, change and pattern were independent factors affecting outcome. Receiver operator characteristic curves showed that endometrial pattern, thickness and changes were not good predictors of clinical pregnancy. The study also concluded that even though endometrium with triple-line or increased thickness may favor pregnancy, combined endometrial characteristics do not predict outcomes.

Endometrial pattern was found not to affect the pregnancy rate in our study however, Type A endometrium was associated with higher implantation rate Our results agree with several studies, including a study by ***Barker et al (2009)*** that analyzed seventy-nine oocyte donation cycles resulting in blastocyst embryo transfer, donors underwent ovarian hyper-stimulation using rFSH and GnRH-antagonist and recipients were synchronized to donors using GnRH-agonist down-regulation followed by fixed dose of estrogen (E2) and progesterone (P4) following hCG, transvaginal ultrasound (US) obtained ET and EP 10-11 days after initiation of E2 and

on day of embryo transfer. Fifty-nine cycles resulted in clinical pregnancy and no differences were observed in pregnant vs. non-pregnant cycles in proliferative or secretory ET and EP.

In the study by ***Rashidi et al (2005)***, there was no difference between pregnant and nonpregnant patients in mean endometrium thickness (10.1 1 versus 10.2 2, p=0.79), which also coincides with our results. However, pregnancies occurred only in patients with an endometrial thickness of 9-12 mm (p=0.036). There was no correlation between endometrial pattern and pregnancy rate. The receiver-operating characteristic (ROC) curve and multiple logistic regression showed no significant effect of endometrial thickness in the outcome of IVF/ICSI.

Likewise, a study by ***Puerto et al (2003)*** where 240 patients were evaluated, concluded that ultrasonographic parameters including echogenic pattern as predictors of implantation in assisted reproduction have a limited value in the clinical setting. Only a long protochol was used in that study which differs from our study that used all three protocols.

Other studies revealed otherwise like the study by **Ahmadi et al. (2017)** where the study concluded that ultrasonographic evaluation of endometrial echo-pattern on the day of HCG administration has prognostic value in clinical settings for predicting implantation in ART cycle.

Another study by ***Gingold et al. (2015)*** agrees with our results regarding endometrial thickness but does not when it comes to endometrial echo-pattern, where the study concluded that EnT was not significantly associated with clinical outcomes of euploid ETs. A type 3 EnP at trigger day suggests a prematurely closed window of implantation.

There are conflicting data regarding the possibility of supra-physiologic levels of E2 and P having deleterious effects on the success of IVF or ICSI and ET, referring back to the results of our study no significant difference in the level of E2 or P measured alone on the day of ET nor in the level of combined E2/P ratio among conception and non-conception cycles) nor did those levels have a significant influence upon the implantation rate.

A study by ***Gruber et al. (2007)*** that had the hypothesis that a high P level in combination with a low E2 level in the early luteal phase could cause failed implantation. In this study 239 women treated by IVF or ICSI were retrospectively analyzed and early luteal serum E2 and P were measured on the day of ET, women with clinical pregnancies had significant higher mean E2/P ratios on OI +4 days (p = 0.01), OI +5 days (p = 0.005) and OI +7 days (p = 0.0001) compared with those who had either a preclinical abortion or failed to conceive and mean serum P was higher in women with preclinical abortions compared to clinical pregnancies or non-pregnant cycles, but it did not reach statistical significance and concluded that these retrospective data may hold prognostic value regarding endometrial receptivity as reflected by E2/P measurements and may help improve IVF treatment outcome. These results are contradictory to the results of our study. Perhaps difference in being prospective and having a different sample size could be the cause for this.

A study by ***Abuelghar et al., (2013)*** included fifty seven women treated by ICSI for male factor infertility, the study concluded that measurement of E2/P ratio on the day of embryo transfer in ICSI cycles is not of clinical value to predict clinical pregnancies.

Another study by ***Sonntag et al. (2013)*** Serum was sampled from the day of embryo transfer (ET) and throughout the luteal phase until ET + 14 from patients consecutively enrolling for IVF/ICSI therapy. The luteal phase was supported by vaginal P suppositories only, clinical pregnancies were detected by ultrasound and followed up until the 20th week. Overall pregnancy rate was 30.9% constituting the two study groups of conception cycles (n = 22) and non-conception cycles (n = 49). Significantly, higher E2 (3326 ± 804 versus 1072 ± 233 pmol/l, p = 0.014) and P (244 ± 68 versus 73 ± 10 nmol/l, p = 0.023) were present in conception cycles versus non-conception cycles from as early as ET + 7.

Additionally, a study by ***Singh et al. (2015)*** reviewed data of 544 women undergoing fresh IVF/ICSI cycles (539 cycles) with long agonist protocol, a negative association was observed between pregnancy rate and serum P and P/E2 levels calculated on the day of HCG administration with no effect on fertilization and cleavage rate. The overall cut-off value of serum P and P/E2 ratio detrimental for pregnancy was found to be 1.075ng/ml and ≥0.35, respectively. However, serum E2 levels were not found to be significantly associated with pregnancy rate.

In a systematic review carried out by ***Kosmas (2004)*** concluded that there is no high-quality evidence to support or deny the value of E2 determination on the day of hCG administration for pregnancy achievement in IVF cycles, where pituitary down-regulation is performed with GnRH agonists.

Conclusion:

Finally it can be concluded that ultrasonographic feutures of the endometrium (thickness and echopattern) and E2/P ratio cann't be used as reliable markers for endometrial receptivity in the clinical setting.

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