SJIF Impact Factor: 5.464

WORLD JOURNAL OF ADVANCE HEALTHCARE RESEARCH

ISSN: 2457-0400
Volume: 7.
Issue: 4
Page N. 128-134
Year: 2023

Original Article www.wjahr.com

EVALUATION OF PROLACTIN CHANGES DURING ICSI FRESH CYCLE AS A MARKER OF PREGNANCY

***[1]Dr. Shereen Abdulhussien Kzar, [2]Dr. Rabab Alwan Taher and [3]Dr. Nada Moaide Ragheb**

[1,2]AL Emamian Al-Kadymiain Hospital/Um Albanin Infertility and IVF Center.
[3]Department of Obstetrics & Gynecology Imamein Khadhimein Medical City.

Received date: 16 February 2023 **Revised date:** 06 March 2023 **Accepted date:** 26 March 2023

***Corresponding Author: Dr. Shereen Abdulhussien Kzar**

AL Emamian Al-Kadymiain Hospital/Um Albanin Infertility and IVF Center.

ABSTRACT

Introduction: Prolactin (PRL) may be pituitary or extra-pituitary. Pituitary PRL secretion pulses. The pituitary releases prolactin every day. Prolactin (PRL) levels during in vitro fertilisation (ICSI) infertility therapy are being examined as a predictor of success. **Method:** An observational cross-sectional research analysed 69 fresh embryo transfer ICSI cycles in academic and private infertility clinics. On day 2, day 0 (oocyte pick up), and day 9, hormones were tested (oocyte retrieval). Pregnancy rate and hormones on days 0 and 9 were compared. **Results:** pregnancy rate 22% (n=15), mean serum PRL on day 9 post-oocyte pick up 52.55+- 23.54 in pregnant women, not significantly higher than the mean of 45.05+- 28.33 in sterile women (p-value 0.352). After controlling for baseline S. PRL estimated mean = 78.35, end line readings after 9 days were not statistically significant (p-value = 0.349). FFPRL on D0 as a screening test for pregnancy after ICSI may consistently distinguish between those who succeeded and those who failed (total area under the curve =0.667, P-value =0.5; at the cutoff point of FFPRL level=30 and above, sensitivity=0.667 and specificity=0.685). **Conclusion:** FF PRL on pick-up day (D0) may screen for pregnancy following ICSI. It reliably predicts pregnancy, which is helpful for physicians and patients during the anxious wait for confirmation, which is also affected by psychological variables and limiting activity.

KEYWORDS: Follicular, prolactin, pick up day, pregnancy rate.

INTRODUCTION

Origins of PRL might be extra-pituitary or pituitary.[1] There is pulsatile pituitary PRL secretion. There is a specific daily cycle in the pituitary gland's prolactin production.[2] Pituitary and extra pituitary PRL have same structural properties. It is composed of the ovaries, uterus, endometrium, breast, prostate, lymphocytes, hemopoietin cells, adipose tissue, skin, thymus, lymphatic system, endothelium, and brain.[1,3] A rising amount of evidence supports the pleiotropic role of prolactin in reproduction, development, metabolism, electrolyte transport, behaviour, immunology, and cancer.[4] Prior study has shown that follicular fluid prolactin is not produced locally, but rather originates in the pituitary gland, passively diffuses into the ovary from the circulation, and is regulated by oestrogen.[5] According to more recent study, the ovary may be an extra-pituitary source of prolactin secretion.[6] In addition to the pituitary gland, prolactin gene expression has been detected in the endometrium, T-lymphocytes, brain, skin, breast, follicular fluid, ovarian follicular cells, and amniotic fluid. While the pituitary is the principal source of circulating prolactin, the precise role of extra-pituitary prolactin remains uncertain.[7] PRL has a role in the development of follicles and the maintenance of the corpus luteum.[8] as well as in mammogenesis, lactogenesis, and galactopoiesis, as part of its reproductive function. Moreover, PRL helps to oogenesis and implantation success.[8] Through decreasing kisspeptins, elevated PRL levels inhibit the production of ovarian oestrogens, progesterone, the LH pulse, and GnRH.[9,10] In the human ovary, hyperprolactinemia inhibits granulose cell luteinization, steroidogenesis, and corpus luteum development.[11,12] For optimal reproductive outcomes, it may be necessary to maintain a certain amount of circulating prolactin. Throughout the menstrual cycle, prolactin levels changed, giving evidence for its function in a range of reproductive activities. During controlled ovarian stimulation (COS) for assisted reproductive technology, a particular serum

prolactin level dynamics, characterised by transient hyperprolactinemia, has also been identified.[13,14] In addition, accumulating evidence indicates that prolactin directly influences the activity of granulosa cells.[13] and inhibits the action of gonadotropin in the ovary.[14,23] In granulosa cells, prolactin stimulates progesterone synthesis and inhibits estradiol production.[18,20] by activating several signalling pathways.[21] Reduced aromatase activity is the mechanism through which high prolactin inhibits follicle-stimulating hormone (FSH)-induced estradiol production in preovulatory follicles, according to research.[22,23] In a hyperstimulated cycle, midluteal phase PRL levels are considerably higher than preovulatory phase levels.[24] The purpose of this research is to evaluate if prolactin (PRL) level changes throughout cycles of in vitro fertilisation (ICSI) infertility treatment may be used as a predictor of success.

METHOD

The Fertility Clinic at Al-Sadr Teaching Hospital in Baghdad, Al Najaf city, and the High Institute for Infertility Diagnosis and Assisted Reproductive Technologies / Al-Nahrain University performed this cross-sectional observational research between October 2020 and September 2021. The Arab Faculty for Medical Specialization approved the research. This study comprised 115 ICSI patients and 29 who had their treatments terminated because they failed to complete all tests or produce an oocyte or embryo. 18 patients shifted from a fresh cycle to a segmented one because to moderate or severe OHSS or trigger day progesterone levels over 1.5 ng/mL. After echographic and hormonal confirmation of ovarian stimulation conditions (no endometrial or ovarian pathologies), controlled hyperstimulation cycles were started on days 2 or 3 of the cycle using a recombinant follicular inducer (rFSH: Gonal F, Follitrope) with or without human menopausal gonadotropins (HMG: Menagon, menopure). Once ultrasonography showed follicles larger than 13 mm, patients began an antagonist (cetrorelix acetate-Cetrotide). Serial transvaginal pelvic ultrasonography tracked follicle growth. Following two or more 18-mm follicles, alter the stimulation dosage. Ovitrelle or an agonist (Treptoreline-Decapeptyl) should be given at that stage. Follicle aspiration was performed transvaginally with ultrasound monitoring 36 hours after the trigger under general anaesthesia. ICSI and sperm collection and processing were completed on the same day. Two or three days following ova collection, abdominal ultrasonography implanted embryos. P pessaries at 200 or 400 mg and intramuscular P injections every 3–4 days until a pregnancy test are indicated. Serum BHCG tests 16 days post-pickup confirmed pregnancy. PRL radioimmunoassays measured blood hormone levels (nanograms per millilitre are the unit of measurement). Four samples were obtained on day 2, day 0, and day 9 in the morning. For consistency, most of our samples go to the same clinical lab. A statistical analysis was done using SPSS-27 (Statistical Packages for Social Sciences-version 24). Graphs were used to display descriptive statistics like frequency, percentage, mean, and standard deviation. On the ninth day of work, the Students t-test and ANCOVA, a technique between ANOVA and regression analysis, were employed to examine the significance of differences between quantitative variables' means (quantitative data). Receiver Operating Characteristic The "ROC" curve approach was used to examine any parameter as a diagnostic or screening tool for illness and establish the "cut-off value" with the optimum sensitivity and specificity. After tweaking day zero variables, this was done. AUC explains the ROCS region: "Good": 0.8, "Good": 0.7, "Perfect": 0.9 "Fair" Poorly Poorly Failure Pearson correlation was used to evaluate numerical data correlations. A P-value of 0.05 or less was utilised to determine significance.

RESULTS

54 (78%) of the 69 infertile couples in the research did not conceive, whereas 15 (22%) of them did. On day 9 post-oocyte pick up, the mean serum PRL in pregnant women was 52.55+- 23.54, which is not substantially higher than the mean of 45.05+- 28.33 in sterile women (p-value 0.352). The results show that even after accounting for baseline readings of S. PRL estimated mean = 78.35, the differences between end line readings after 9 days were not statistically significant (p-value = 0.349), indicating that the starting serum PRL level (pick up day: day 0) had no effect on the 9th day post-collection serum level. (Table 1)

Table 1: Difference between means of serum Prolactin levels after 9 days of OPU after adjustment of baseline readings according to ANCOVA test.

Pregnancy	Estimated Serum Progesterone					P value
	Staring mean	9th day mean		95% Confidence Interval		
		Mean	Std.error	Lower Bound	Upper Bound	
Not pregnant	78.35	45.023[a]	3.761	37.514	52.532	0.349
Pregnant		52.663[a]	7.161	38.365	66.961	

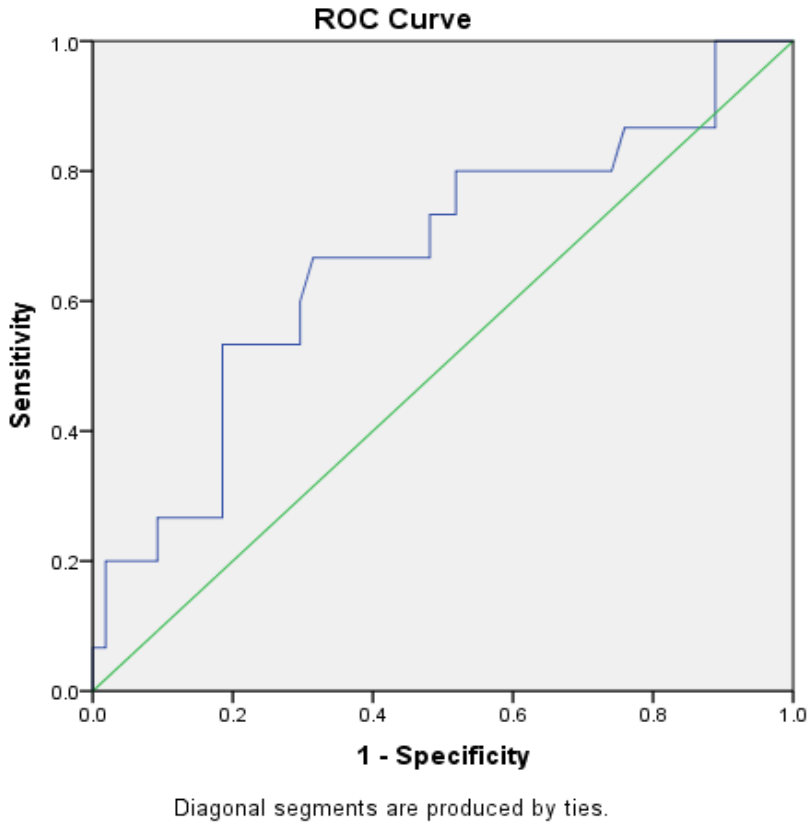

Figure 1 ROC curve for analysis of OPUD FF prl level.

Table 2: Area Under the Curve according which one can differentiate correctly between those who are pregnant and who are not depending on OPUD prl FF.

Test Result Variable(s): OPUD.prlFF				
Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.667	.084	.050	.502	.831

Coordinates of the Curve		
Test Result Variable(s): OPUD.prlFF		
Positive if Greater Than or Equal To[a]	Sensitivity	1 - Specificity
4.9750	1.000	.889
7.9000	.933	.889
10.9500	.867	.889
12.2000	.867	.870
22.8000	.800	.519
30.0000	.667	.315
32.4450	.600	.296
34.8450	.533	.296
39.3250	.533	.204
47.2000	.267	.130
49.4450	.267	.111

Roc curve in Fig.1 and table 2: show that FFPRL on D0 as a screening test to determine the likelihood of becoming pregnant after ICSI can accurately distinguish between those who succeeded and those who failed (total area under the curve =0.667, P-value =0.5); at the cutoff point of FFPRL level=30 and above, sensitivity=0.667 and specificity =0.685.

Table 4: Correlation between measured numerical variables.

		CD2E2	PrlFFDO	PrlSd0	PrlSD9	M2	TNO	G1	SD	AMH	Mage	NET
TDE2	r	.096	.157	.086	-.160-	.572**	.660**	.106	.053	.359**	-.223	.117
	pv	.433	.197	.484	.190	.000	.000	.386	.663	.002	.065	.337
CD2E2	r		.051	-.089-	-.219-	-.072	.058	-.034	.007	.045	-.004	.133
	pv		.678	.466	.071	.558	.639	.779	.957	.715	.973	.277
PRLFF	r			.138	.040	.197	.236	.272*	.155	.102-	-.094	.186
	pv			.259	.743	.105	.051	.024	.203	.406	.444	.127
PRLSD0	r				.007	.007	.040	-.288	.044	-.092-	-.074	-.283
	pv				.956	.955	.746	.016	.720	.452	.547	.018
PRLSD9	r					-.013	.026	.278*	.103	.021	-.017	.232
	pv					.914	.832	.021	.399	.862	.890	.055
M2	r						.835**	.281*	-.079	.324	-.213	.239*
	pv						.000	.019	.521	.007	.079	.048
TNO	r							.235	.007	.447	-.299	.286*
	pv							.052	.953	.000	.013	.017
G1	r								.048	.087	-.002	.656**
	Pv								.692	.477	.990	.000
SD	r									-.067	.027	.037
	pv									.586	.823	.763
AMH	r										-.302	.113
	pv										.012	.353
Mage	r											-.007
	pv											.957
M2=Mature Oocyte.G1=Grade1 embryo.SD=Stimulation duration.NTO=number of total oocytes .NET=Transferred embryoETD=Embryo transfer day												
Weak correlation r=<0.3, intermediate correlation r=0.3-0.6, strong correlation r=>0.6												
PV<0.05 significant correlation, PV<0.01 highly significant correlation												

Table 4: It shows that Significant positive correlation were noticed between Trigger day E2 level (TDE2) and getting Mature oocyte (MII) (r=0.572, pv=0.01), Total number of oocytes (TNO)(r=0.660, pv=0.001),and AMH (r=0.359,pv=0.002). Significant negative correlation was found between TNO and Maternal age (M. age) (r=-0.299, pv=0.13), and between M. age and AMH (r=0.302, pv=0.012). Significant positive correlation was noticed between FFPRL and G1(r=0.272, pv=0.024). Significant negative correlation was noticed between serum OPUPRL and G1(r=0.288, m pv=0.016). Significant positive correlation was noticed between D9 SPRL and G1(r=0.278, pv=0.21).

DISCUSSION

The use of IVF provides the ideal opportunity to contrast the potential effects of PRL and gonadotropin suppression on reproduction.[1] So, maintaining a certain amount of circulating prolactin may be necessary for the best reproductive outcomes.[13] The timing of blastocyst competence and uterine receptivity, sometimes referred to as the "window of implantation," is an important factor in implantation. Many elements have been shown to obstruct this sensitive, closely regulated process.[6] The majority of ART procedures include giving the patient hormones in an effort to boost the ovary's follicle count. Yet, regardless of the quality of the embryo, these hormonal effects on the endometrium vary dramatically from those of typical cycles and may alter the "window of implantation," making pregnancy more difficult.[25] One of the additional effects of PRL (2000) Binart is the ovaries' synthesis of progesterone.[26] The idea that prolactin could be involved in the implantation process stemmed from the fact that it can impact both the uterus and the blastocyst.[6] The success rate of our trial, which included 69 women aged 20 to 46, was 22%. IVF cycles in the US had an average success rate of 20–35%, with the greatest success rates circling around 40%, according to the National Infertility Association, which is consistent with the fact that the majority of our patients were older. With the first IVF round, women between the ages of 40 and 42 had a 12% live birth rate (Honor et al).[27] In our research, we measured blood prolactin hormone early in the follicular phase (cd2), in the follicular follicle, and at the day of the midfollicular phase's opening addition (D9 of opu.). Our research, which is consistent with Paulina A. et al. (2018), revealed no relationship between the hormone level tested on day 9 after opu with endometrial receptivity or success in predicting pregnancy.[28] but not with Ozaki et alresearch .'s (2001).[29] discovered that individuals who had miscarriage had considerably lower prolactin levels. According to our research, pregnancy and FF prolactin levels at opu day are strongly correlated. The authors' contradictory study found no association between follicular fluid prolactin levels and IVF success.[30] Patients with or without transient hyperprolactinemia had similar numbers of oocytes and pregnancy rates during gonadotropin-stimulated IVF cycles, according to

Hofmann et al.[31] According to Lee et al.[32] unfertilized oocytes exhibited higher amounts of prolactin in their follicular fluid, while Reinthaller et al. showed that prolactin levels in follicular fluid dropped as follicular maturation advanced.[33] Forman et al. also found no association between greater plasma or follicular fluid prolactin levels and the development of oocytes or embryos or the incidence of pregnancy in individuals undergoing ovarian stimulation for IVF.[34] These findings concerning S prolactin at OP day are supported by these data, but not those about FF prolactin from our investigations. According to our research, robust embrys quality is related with high serum and follicular PRL on OPU day and even in the ninth day after pick-up (grad1; G1). In a small study of couples receiving ICSI for male factor infertility, it was discovered that the levels of prolactin, progesterone, growth hormone, interleukin-1 (IL-1), and tumour necrosis factor were higher in follicles producing oocytes that subsequently fertilised compared to those of oocytes that failed to fertilise.[35] Gonen et al. study's showed no variations in the quantity of oocytes recovered or fertilisation rates based on prolactin levels assessed the day after HCG injection.[36] Nonetheless, some studies showed that transient hyperprolactinemia can have a deleterious influence on follicular or oocyte development.[37,38] Reinthaller et al. found that following gonadotropin stimulation, patients with transitory hyperprolactinemia had a lower fertilisation rate than those with low prolactin levels.[38]

CONCLUSION

For the purpose of estimating the likelihood of pregnancy after ICSI, FF PRL on the day of retrieval (D0) may be utilised as a screening test. This test can reliably determine whether a woman will become pregnant or not, which is extremely helpful for both doctors and patients during the time leading up to the confirmation date. During this time, which is marked by high levels of stress, the psychosocial effects of medication, and restricted activity, patients are often under a lot of stress.

REFERENCES

1. Freeman ME, Kanyicska B, Lerant A, etal Prolactin: Structure, Function, and Regulation of Secretion.physiological.review2000.80.4.1523https://journals.physiology.org/doi/full/10.1152/physrev.2000.80.4.1523
2. Capozzi A, Scambia G, Pontecorvi A, Lello S. Hyperprolactinemia: Pathophysiology and therapeutic approach. Gynecol Endocrinol, 2015; 31: 506–510. doi: 10.3 109/09513590. 2015.1017810. https://pubmed.ncbi.nlm.nih.gov /26291795/.
3. Marano R.J., Ben-Jonathan N. Minireview: Extrapituitary prolactin: an update on the distribution, regulation, and functions. Mol Endocrinol, 2014; 28: 622–633. doi: 10.1210/me.2013-1349. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5414853/
4. Bernard, V.; Young, J.; Chanson, P.; Binart, N. New insights in prolactin: Pathological implications. Nat. Rev. Endocrinol, 2015; 11: 265–275.
5. Ohwaki, M.; Suganuma, N.; Seo, H.; Nawa, A.; Kikkawa, F.; Narita, O.; Matsui, N.; Tomoda, Y. Source of Prolactin in Human Follicular Fluid. Endocrinol. JPN, 1992; 39: 601–607. https://www.jstage.jst.go.jp/article/endocrj1954/39/6/39_6_601/_pdf/-char/en
6. Perks, C.M.; Newcomb, P.V.; Grohmann, M.; etal. Prolactin acts as a potent survival factor against C2-ceramide-induced apoptosis in human granulosa cells. Hum. Reprod. 2003, 18, 2672–2677. https://academic.oup.com/humrep/article/18/12/2672/2913471
7. Nawroth, F. Hyperprolactinaemia and the regular menstrual cycle in asymptomatic women: Should it be treated during therapy for infertility? Reprod. Biomed Online 2005, 11, 581–588. https://www.sciencedirect.com/science/article/abs/pii/S1472648310611662
8. Ignacak A, Kasztelnik M, Sliwa T, Korbut RA, Rajda K, Guzik TJ. Prolactin-not only lactotrophin. A "new" view of the "old" hormone. J Physiol Pharm 2012; 63:435–443. https://pubmed.ncbi.nlm.nih.gov /23211297/
9. Vilar L, Abucham J, Albuquerque JL, et al. Controversial issues in the management of hyperprolactinemia and prolactinomas—An overview by the Neuroendocrinology Department of the Brazilian Society of Endocrinology and Metabolism. Arch Endocrinol Metab, 2018; 62: 236–263. doi: 10.20945/2359-3997000000032. https://www.scielo.br/j/aem/a/YYhNDhks3xZndj8xG99bM3F/?lang=en
10. Kokay IC, Petersen SL, Grattan DR. Identification of prolactin- sensitive GABA and kisspeptin neurons in regions of the rat hypothalamus involved in the control of fertility. Endocrinology, 2011; 152: 526–535. https://pubmed.ncbi.nlm.nih.gov/21177834/
11. Adashi EY, Resnick CE. Prolactin as an inhibitor of granulosa cell luteinization: implications for hyperprolactinemia-associated luteal phase dysfunction. Fertil Steril, 1987; 48: 131–139. https://pubmed.ncbi.nlm.nih.gov/3595910/
12. McNeilly AS, Glasier A, Jonassen J, Howie PW. Evidence for direct inhibition of ovarian function by prolactin. J Reprod Fertil, 1982; 65: 559–569. https://pubmed.ncbi.nlm.nih.gov/6808130/
13. Zhong, Y.-P.; Shen, X.-T.; Ying, Y.; Wu, H.-T.; Li, J.; Qi, Q.; Zhou, C.-Q.; Zhuang, G.-L. Impact of Transitory Hyperprolactinemia on Clinical Outcome of In Vitro Fertilization and Embryo Transfer. J. Med Biochem, 2011; 31: 27–33. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5941656/
14. Crosignani, P.G.; Maini, M.C.; Negri, E.; Ragni, G. Human prolactin release induced by follicle

stimulating hormone, luteinizing hormone and human chorionic gonadotrophin. Hum. Reprod, 1991; 6: 1070–1073. [CrossRef] [PubMed]
15. Kamel, A.; Halim, A.A.; Shehata, M.; Alfarra, S.; El-Faissal, Y.; Ramadan, W.; Hussein, A.M. Changes in serum prolactin level during intracytoplasmic sperm injection, and effect on clinical pregnancy rate: A prospective observational study. BMC Pregnancy Childbirth, 2018; 18: 141. [CrossRef] [PubMed]
16. McNeilly, A.S.; Glasier, A.; Jonassen, J.; Howie, P.W. Evidence for direct inhibition of ovarian function by prolactin. Reproduction, 1982; 65: 559–569.
17. Hsueh, A.J.W.; Adashi, E.Y.; Jones, P.B.C.; Welsh, J.T.H. Hormonal Regulation of the Differentiation of Cultured Ovarian Granulosa Cells*. Endocr. Rev., 1984; 5: 76–127.
18. Fortune, J.E.; Wissler, R.N.; Vincent, S.E. Prolactin Modulates Steroidogenesis by Rat Granulosa Cells: II. Effects on Estradiol. Biol.Reprod, 1986; 35: 92–99. https://academic.oup.com/biolreprod/article/35/1/92/2764369
19. Veldhuis, J.D.; Klase, P.; Hammond, J.M. Divergent Effects of Prolactin upon Steroidogenesis by Porcine Granulosa Cells in Vitro:Influence of Cytodifferentiation. Endocrinology, 1980; 107: 42–46. https://www.mdpi.com/1424-8247/16/1/122.
20. Jones, P.B.C.; Valk, C.A.; Hsueh, A.J.W. Regulation of Progestin Biosynthetic Enzymes in Cultured Rat Granulosa Cells: Effects of Prolactin, β 2-Adrenergic Agonist, Human Chorionic Gonadotropin and Gonadotropin Releasing Hormone. Biol. Reprod, 1983; 29: 572–585. https://pubmed.ncbi.nlm.nih.gov/6138106/
21. Russell, D.L.; Richards, J.S. Differentiation-dependent prolactin responsiveness and stat (signal transducers and activators of transcription) signaling in rat ovarian cells. Mol. Endocrinol, 1999; 13: 2049–2064.
22. Dorrington, J.H.; Gore-Langton, R.E. Antigonadal Action of Prolactin: Further Studies on the Mechanism of Inhibition of Follicle-Stimulating Hormone-Induced Aromatase Activity in Rat Granulosa Cell Cultures. Endocrinology, 1982; 110: 1701–1707. https://pubmed.ncbi.nlm.nih.gov/6804209/
23. Uilenbroek, J.; van der Schoot, P.; Besten, D.D.; Lankhorst, R.R. A Possible Direct Effect of Prolactin on Follicular Activity.Biol. Reprod, 1982; 27: 1119–1125. https://pubmed.ncbi.nlm.nih.gov/7159658/
24. Balasch J, Creus F, Fabregues F, Carmona F, CasamitjanaR, Penarrubia J, et al.: Hormonal profiles in successful and unsuccessful implantation in IVF-ET after combined GnRHagonist/ gonadotropin treatment for superovulation and hCGluteal support. Gynecol Endocrinol, 1995; 9: 51–58. https://pubmed.ncbi.nlm.nih.gov/7793300/
25. Evans, J.; Hannan, N.J.; Hincks, C.; Rombauts, L.J.F.; Salamonsen, L.A. Defective Soil for a Fertile Seed? Altered Endometrial Development Is Detrimental to Pregnancy Success. PLoS ONE, 2012; 7: e5309. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3533948/.
26. BinartNHellocoCOrmandyC. JBarraJClement-lacroixPBaran N & Kelly PA Rescue of preimpl antatory egg development and embryo implantation in prolactin receptor-deficient mice after progesterone administration.Endocrinology1412691-2697, 2000.
27. Honor Whiteman, Prolonging IVF treatment could boost success rates; Medical news today, December 22, 2015.
28. Paulina A. Santander Pérez,[1] Álvaro P. Ceschin,[et al;]Early serum progesterone and prolactin analysis at day 9 of oocyte retrieval as a predictor of success in fresh ICSI cycles; JBRA Assist Reprod, 2018 Apr-Jun; 22(2): 95–98. doi: 10.5935/1518-0557.20180008 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5982552/
29. Ozaki T, Takahashi K, Kurioka H, Miyazaki K. Influence of midluteal serum prolactin on outcome of pregnancy after IVF-ET: a preliminary study. J Assist Reprod Genet, 2001; 18: 387–390. doi: 10.1023/A:1016674523317. https://pubmed.ncbi.nlm.nih.gov/11499323/.
30. Romão, G.S.; Ferriani, R.A.; Moura, M.D.; Martins, A.R. Screening for prolactin isoforms in the follicular fluid of patients undergoing in vitro fertilization. Gynecol. Obstet. Investig, 2002; 54: 46–49. https://pubmed.ncbi.nlm.nih.gov/12297718/.
31. Hofmann, G.E.; Denis, A.L.; Scott, R.T.; Muasher, S.J. The incidence of transient hyperprolactinemia in gonadotropin-stimulated cycles for in vitro fertilization and its effect on pregnancy outcome. Fertil Steril, 1989; 4: 622–626. https://pubmed.ncbi.nlm.nih.gov/2806600/.
32. Lee, M.; Ben-Rafael, Z.; Meloni, F.; Mastroianni, L.; Flickinger, G.L. Relationship of human oocyte maturity, fertilization, and cleavage to follicular fluid prolactin and steroids. J. In Vitro Fertil. Embryo Transf, 1987; 4: 168–172. https://link.springer.com/article/10.1007/BF01555465.
33. Reinthaller, A.; Deutinger, J.; Riss, P.; Müller-Tyl, E.; Fischl, F.; Bieglmayer, C.; Janisch, H. Relationship between the steroid and prolactin concentration in follicular fluid and the maturation and fertilization of human oocytes. J. In Vitro Fertil. Embryo Transf, 1987; 4: 228–231. https://pubmed.ncbi.nlm.nih.gov/3625003/.
34. Forman, R.; Fishel, S.; Edwards, S.; Walters, E. The Influence of Transient Hyperprolactinemia on in Vitro Fertilization in Humans. J. Clin. Endocrinol. Metab, 1985; 60: 517–52. https://pubmed.ncbi.nlm.nih.gov/3919045/
35. Mendoza, C.; Cremades, N.; Ruiz-Requena, E.; Martinez, F.; Ortega, E.; Bernabeu, S.; Tesarik, J. Relationship between fertilization results after

intracytoplasmic sperm injection, and intrafollicular steroid, pituitary hormone and cytokine concentrations. Hum. Reprod, 1999; 14: 628–635. https://pubmed.ncbi.nlm.nih.gov/10221687/

36. Gonen, Y.; Casper, R.F. The influence of transient hyperprolactinemia on hormonal parameters, oocyte recovery, and fertilization rates in in vitro fertilization. J. In Vitro Fertil. Embryo Transf, 1989; 6: 155–159. https://pubmed.ncbi.nlm.nih.gov /2794732/
37. Sopelak, V.M.; Whitworth, N.S.; Norman, P.F.; Cowan, B.D. Bromocriptine inhibition of anesthesia-induced hyperprolactinemia: Effect on serum and follicular fluid hormones, oocyte fertilization, and embryo cleavage rates during in vitro fertilization. Fertil. Steril, 1989; 52: 627–632. https://pubmed.ncbi.nlm.nih.gov/2806601/.
38. Reinthaller, A.; Bieglmayer, C.; Deutinger, J.; Csaicsich, P. Transient hyperprolactinemia during cycle stimulation: Influence on the endocrine response and fertilization rate of human oocytes and effects of bromocriptine treatment. Fertil Steril, 1988; 3: 432–436. https://pubmed.ncbi.nlm.nih.gov /3342894/.