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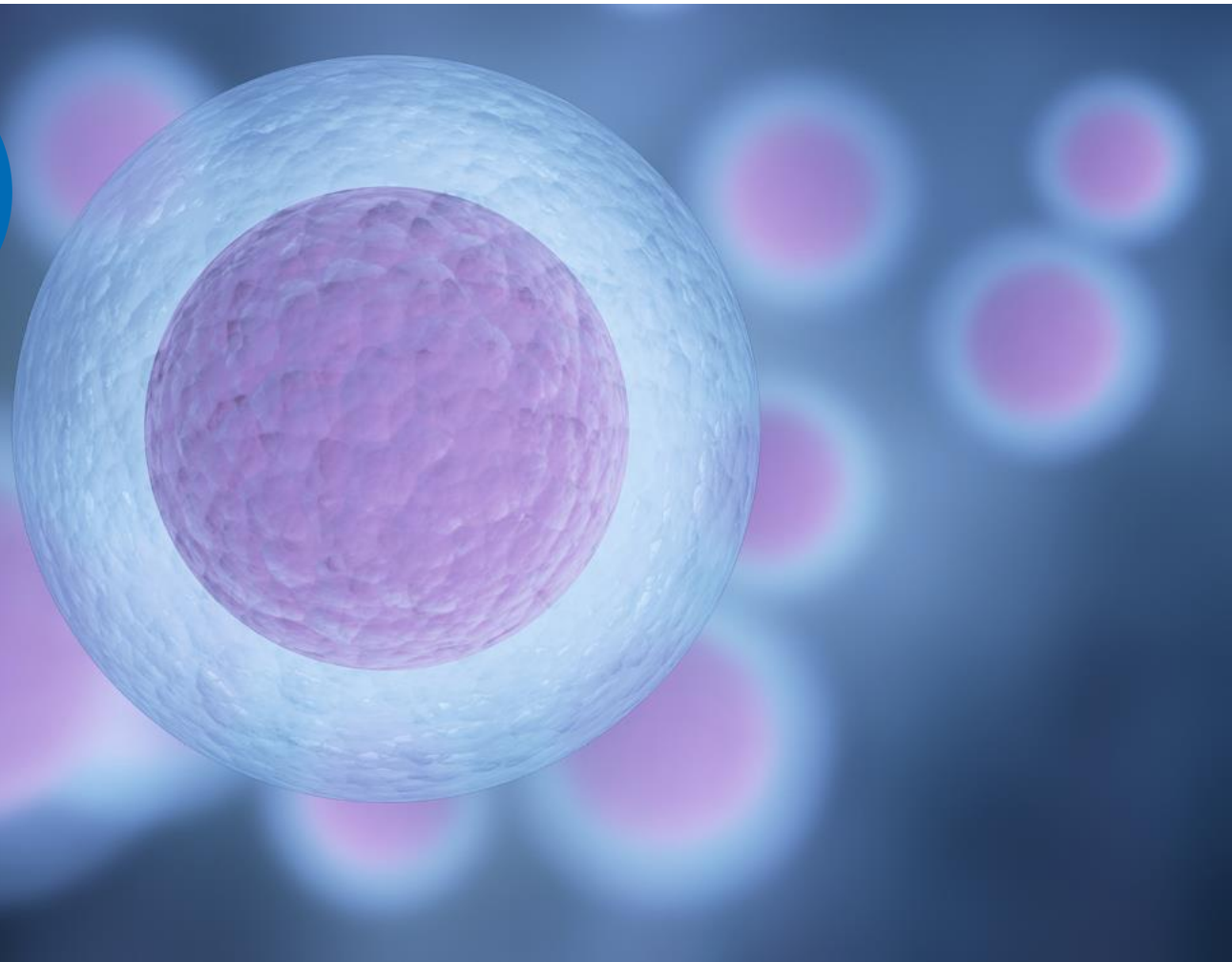
The endometrium during COH: What ongoing parameters are indicating to postpone embryo transfer?

Carlo Alviggi, MD, PhD



The endometrium during COH: What ongoing parameters are indicating to postpone embryo transfer?

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Frozen embryo transfer

Is there a specific endometrial pattern that could correlate with embryo implantation and indicate to postpone ET?

- Endometrial thickness
- “Triple line” pattern
- Vascularization
- Integrated evaluation

May we consider FET (cycle segmentation) as more efficient procedure in all IVF cycles?

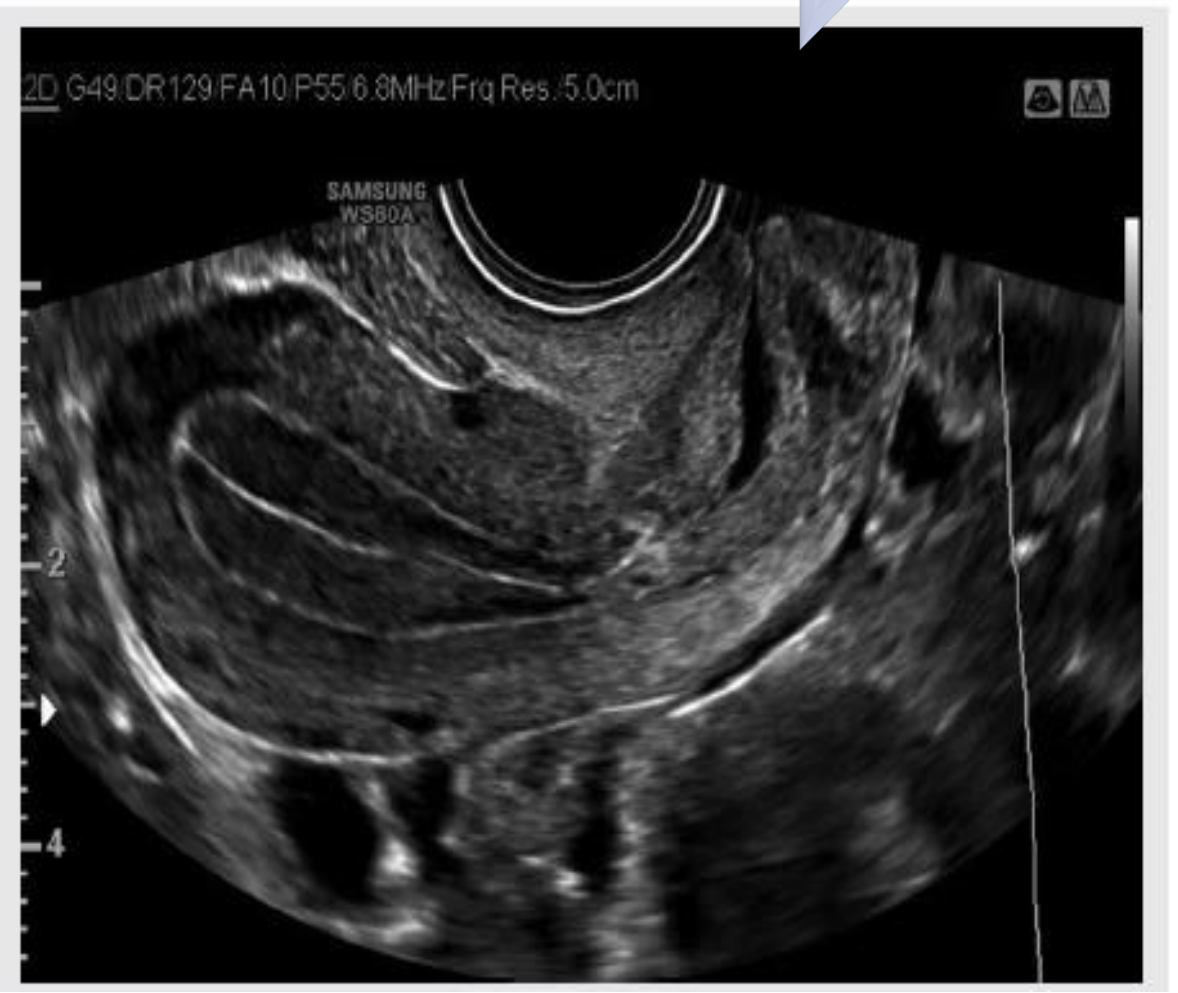
- Reduced risk of OHSS
- Less detrimental effect related to ovarian stimulation
- Potentially better clinical outcome?
- Better neonatal and perinatal outcome?

Endometrial thickness | Triple-line pattern | Vascularization | Integrated evaluation

Endometrial thickness is a biomarker for serum estrogen thickening as a response to increasing circulating estrogen levels

Endometrial thickening have been repeatedly tested and compared with pregnancy rates in IVF cycles with conflicting results

Klement and Tepper 2016 Fertil Steril



Endometrial thickness | Triple-line pattern | Vascularization | Integrated evaluation

Current data indicate that endometrial thickness has a limited capacity to identify women who have a low chance to conceive after IVF. The frequently reported cut-off of 7 mm is related to a lower chance of pregnancy, nut the use of thickness as a tool to decide on cycle cancellation, freezing of all embryos or refraining from further IVF treatment seems not to be justified Kasius et al. 2014 Hum Reprod Update

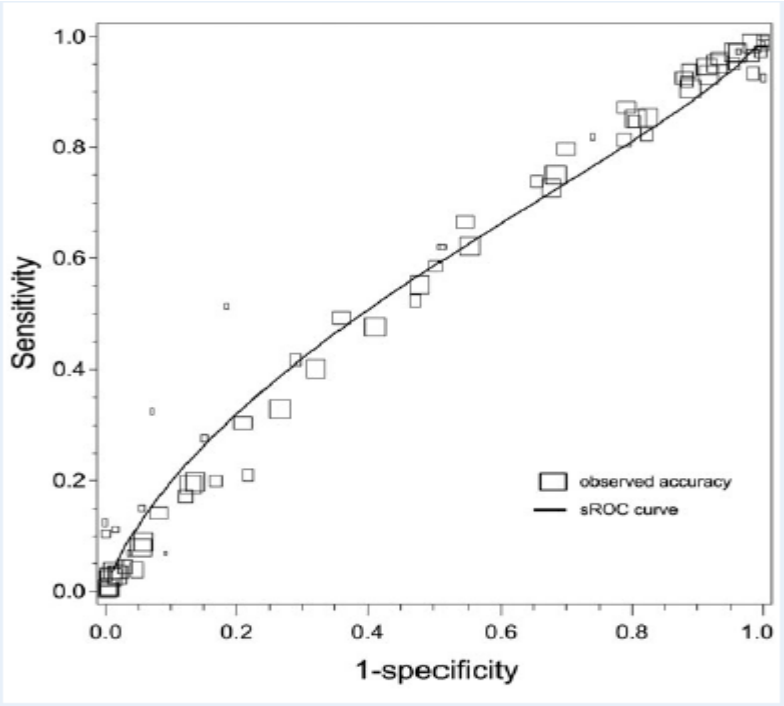


Figure 3 Summary ROC curve. EMT in the prediction of clinical pregnancy for all studies and all cut-off values reported. Block size reflects the sample size of the studies. EMT has no discriminatory capacity for clinical pregnancy (AUC-ROC 0.56 and curve close to the $X = Y$ line). ROC, receiver operating characteristic; AUC, area under the curve.

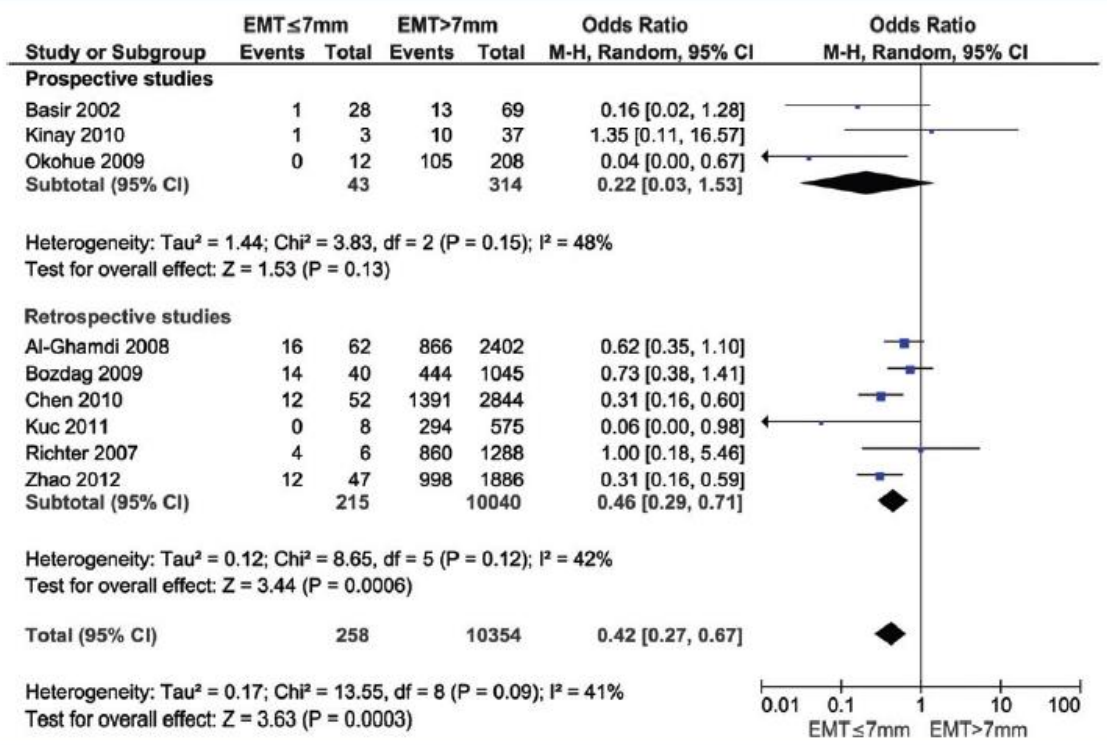


Figure 6 Forest plot of clinical pregnancy for women with EMT ≤ 7 mm and women with EMT > 7 mm. The probability of clinical pregnancy is significantly lower for women with EMT ≤ 7 mm. The I^2 statistic was 41%, indicating that study heterogeneity was low.

Endometrial thickness | Triple-line pattern | Vascularization | Integrated evaluation

Endometrial thickness was not significantly associated with clinical outcomes of euploid ETs.

Clinical outcomes separately divided by EnT and EnP.

Subset	Grouped by	Cycles (n)	Total ET	Total GS	Total pregs	Total CP	IR (95% CI)	PR (95% CI)	CPR (95% CI)
All	EnT at trigger (mm)								
	≤7	23	28	12	13	12	0.43 (0.24–0.63)	0.57 (0.34–0.77)	0.52 (0.31–0.73)
	7–8	48	54	29	35	26	0.54 (0.40–0.67)	0.73 (0.58–0.85)	0.54 (0.39–0.69)
	8–9	53	73	40	39	30	0.55 (0.43–0.66)	0.74 (0.60–0.85)	0.57 (0.42–0.70)
	9–10	44	60	31	32	27	0.52 (0.38–0.65)	0.73 (0.57–0.85)	0.61 (0.45–0.76)
	10–11	34	46	21	22	19	0.46 (0.31–0.61)	0.65 (0.46–0.80)	0.56 (0.38–0.73)
	11–12	25	36	19	14	13	0.53 (0.35–0.70)	0.56 (0.35–0.76)	0.52 (0.31–0.72)
	>12	14	19	8	10	7	0.42 (0.20–0.67)	0.71 (0.42–0.92)	0.50 (0.23–0.77)
Fresh	EnT at transfer (mm)								
	≤7	12	17	6	7	5	0.35 (0.14–0.62)	0.58 (0.28–0.85)	0.42 (0.15–0.72)
	7–8	36	50	26	24	22	0.52 (0.37–0.66)	0.67 (0.49–0.81)	0.61 (0.43–0.77)
	8–9	38	48	23	23	17	0.48 (0.33–0.63)	0.61 (0.43–0.76)	0.45 (0.29–0.62)
	9–10	24	30	11	13	9	0.37 (0.20–0.56)	0.54 (0.33–0.74)	0.38 (0.19–0.59)
	10–11	25	36	11	14	10	0.31 (0.16–0.48)	0.56 (0.35–0.76)	0.40 (0.21–0.61)
	11–12	20	31	19	15	15	0.61 (0.42–0.78)	0.75 (0.51–0.91)	0.75 (0.51–0.91)
	>12	21	28	16	17	12	0.57 (0.37–0.76)	0.81 (0.58–0.95)	0.57 (0.34–0.78)
Frozen	EnT at transfer (mm)								
	≤7	17	24	12	13	12	0.50 (0.29–0.71)	0.76 (0.50–0.93)	0.71 (0.44–0.90)
	7–8	73	87	48	57	45	0.55 (0.44–0.66)	0.78 (0.67–0.87)	0.62 (0.50–0.73)
	8–9	27	38	19	20	16	0.50 (0.33–0.67)	0.74 (0.54–0.89)	0.59 (0.39–0.78)
	9–10	17	25	13	14	11	0.52 (0.31–0.72)	0.82 (0.57–0.96)	0.65 (0.38–0.86)
	10–11	20	23	13	16	12	0.57 (0.34–0.77)	0.80 (0.56–0.94)	0.60 (0.36–0.81)
	11–12	13	17	9	11	9	0.53 (0.28–0.77)	0.85 (0.55–0.98)	0.69 (0.39–0.91)
	>12	13	22	8	7	7	0.36 (0.17–0.59)	0.54 (0.25–0.81)	0.54 (0.25–0.81)

Gingold et al. 2015 Fertil Steril

Endometrial thickness | Triple-line pattern | Vascularization | Integrated evaluation

frontiers in Endocrinology

ORIGINAL RESEARCH
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The Effects of Endometrial Thickness on Pregnancy Outcomes of Fresh IVF/ICSI Embryo Transfer Cycles: An Analysis of Over 40,000 Cycles Among Five Reproductive Centers in China

Jianing Xu[†], *Shaodi Zhang*[†], *Lei Jin*[2], *Yundong Mao*[3], *Juanzi Shi*[4], *Rui Huang*[5], *Xiao Han*[1], *Xiaoyan Liang*[5*‡] and *Cuilian Zhang*[1*‡]

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Objective: To investigate the effects of endometrial thickness (EMT) on pregnancy outcomes on hCG trigger day in fresh *in vitro* fertilization (IVF) and intracytoplasmic sperm injection (ICSI) cycles.

Methods: A total of 42,132 fresh cycles between 1 January 2013 and 31 December 2019 were included in this retrospective cohort study. Data were collected from five reproductive centers of large academic or university hospitals in China. All patients were divided into different groups according to their endometrial thickness on hCG trigger day. Multivariate regression analysis, curve fitting and threshold effect analysis were performed.

Results: After adjusting for age, body mass index, infertility type, number of embryos transferred, number of retrieved oocytes and COS (controlled ovarian stimulation) protocols, significant associations were found between endometrial thickness and clinical pregnancy rate (adjusted odds ratio [aOR]: 1.05; 95% confidence interval [CI]: 1.06–1.08, P < 0.0001), live birth rate (aOR: 1.04; 95% CI: 1.03–1.05, P < 0.0001) as well as miscarriage rate(aOR: 0.96; 95% CI: 0.94 – 0.98, P < 0.0001). When the endometrial thickness was less than 12mm, the clinical pregnancy rate and live birth rate were increased significantly by 10% and 9%(OR:1.10; 95%CI: 1.08-1.12, OR:1.09; 95%CI: 1.07-1.11), respectively, along with the increase of each millimeter increment of endometrial thickness. However, when the EMT ranged from 12-15 mm, were stable at the ideal level, that were not significantly associated with EMT growth. Additionally, clinical

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pregnancy rate and live birth rate were slightly reduced by 6% and 4% when EMT was ≥15mm. Meanwhile, the miscarriage rate was significantly declined by 8% (OR:0.92; 95% CI: 0.90-0.95)with each millimeter increment of EMT. And when EMT was thicker than 12mm, the miscarriage rate didn't change any more significantly.

Conclusions: Endometrial thickness exhibits a curvilinear relationship with pregnancy outcomes in fresh embryo transfer cycles. Clinical pregnancy rate, live birth rate and miscarriage rate may achieve their optimal level when EMT ≥ 12 mm, but some adverse pregnancy outcomes would be observed when EMT ≥15 mm especially for clinical pregnancy.

Keywords: IVF/ICSI, clinical pregnancy rate, endometrial thickness, live birth rate (LBR), fresh embryo transfer

Xu et al. 2022 Front Endocrinol (Lausanne)

Analysis of live birth rates from 96,000 autologous embryo transfers Canadian IVF Registry

Live birth rates increase significantly until an endometrial thickness of 10–12 mm in fresh cycle while in FET cycles live birth rates plateau after 7–10 mm. However, an endometrial thickness <6 mm was associated clearly with a dramatic reduction in live birth rates in fresh and frozen embryo transfer cycles.

Mahutte et al. 2022 Fertil Steril

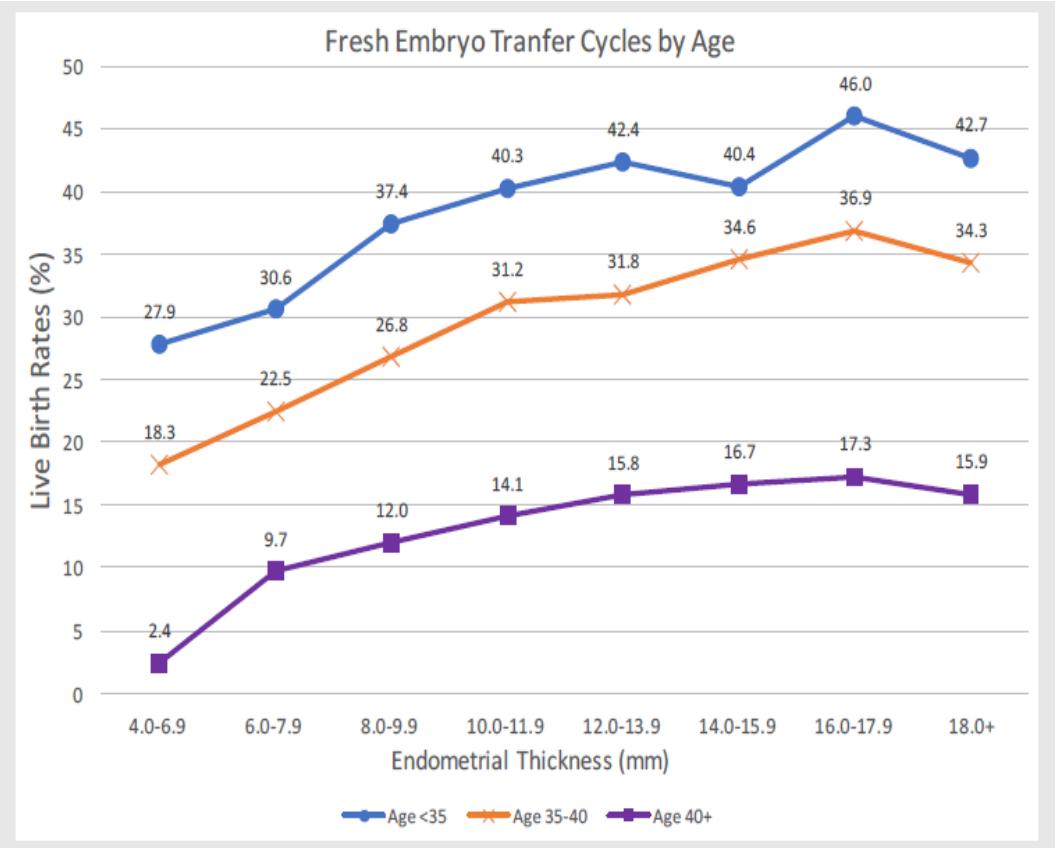

TABLE 2

Clinical outcomes in FET cycles by endometrial thickness

Endometrial thickness (mm)	Clinical pregnancy rate	Live birth rate	Pregnancy loss rate	Mean term singleton birth weight in grams (SD)
≥18	44.1% (60/136)	30.9 (42/136)	41.7% (30/72)	3,496 (432)
16–17.9	45.0% (159/353)	32% (113/353)	38.9% (72/185)	3,529 (563)
14–15.9	42.1% (604/1,434)	29.2% (419/1,434)	41.6% (299/718)	3,474 (450)
12–13.9	41.9% (2,134/5,094)	30.7% (1,566/5,094)	38.9% (998/2,564)	3,486 (441)
10–11.9	42.3% (5,728/13,539)	30.8% (4,169/13,539)	40.8% (2,875/7,044)	3,452 (442)
8–9.9	40.7% (10,218/25,089)	29.4% (7,375/25,089)	41.3% (5,197/12,572)	3,451 (445)
7–7.9	39.3% (2,476/6,302)	28.4% (1,791/6,302)	41.9% (1,293/3,084)	3,407 (424)
6–6.9	31.5% (334/1,059)	22.6% (239/1,059)	46.0% (204/443)	3,378 (440)
<6	29.1% (108/371)	15.1% (56/371)	62.2% (92/148)	3,412 (394)
*P**	<.001	<.001	<.001	<.001

SD = Standard deviation.
* *P* values for differences in pregnancy outcome rates across endometrial thickness strata.

Mahutte. Optimal endometrial thickness in IVF. Fertil Steril 2021.

Endometrial thickness | Triple-line pattern | Vascularization | Integrated evaluation

19/01/2023 21:30 LBR in fresh and frozen transfers increases with greater endometrial thickness, but only up to a point

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ENDOMETRIAL THICKNESS

LBR in fresh and frozen transfers increases with greater endometrial thickness, but only up to a point

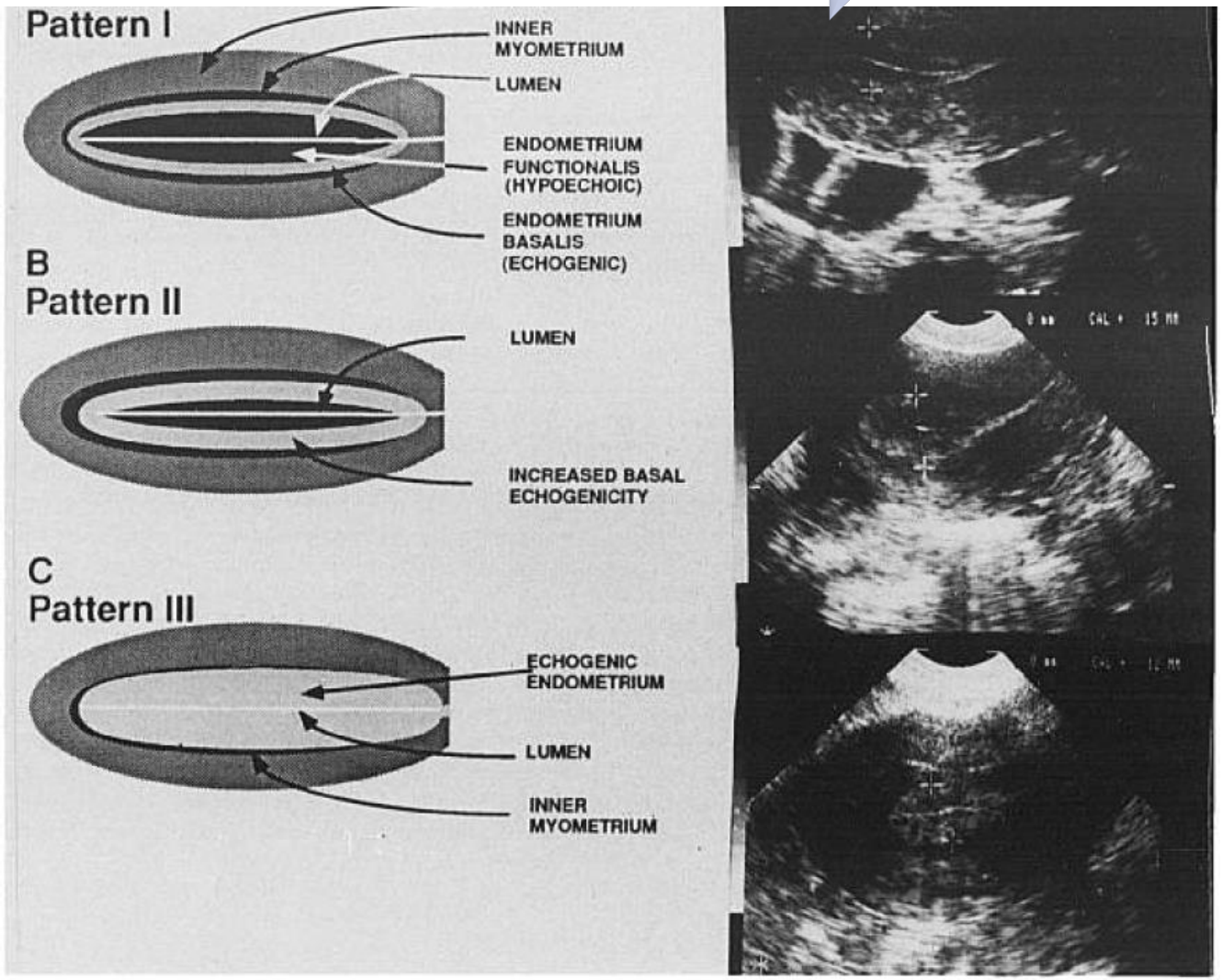
LBRs for fresh transfer plateaued after 10–12 mm… Beyond these thresholds, the authors say they were unable to find an endometrial thickness beyond which live birth rates significantly declined.

Pattern I. Late proliferative: Hyperechoic endometrium constituting less than 50% of the endometrial thickness with a hyperechoic basalis and a hypoechoic functionalis.

Pattern II. Early secretory: Hyperechoic basalis and functionalis extending to more than 50% of the endometrial thickness, but not encompassing the entire endometrial cavity.

Pattern III. Mid-late secretory: Homogeneous hyperechoic functionalis extending from the basalis to the lumen.

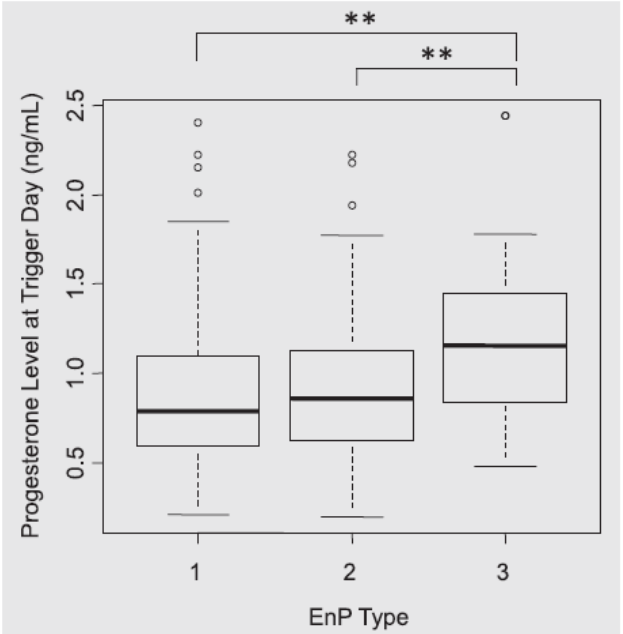
Grunfeld et al. 1991 Obstet Gynecol



Endometrial thickness | **Triple-line pattern** | Vascularization | Integrated evaluation

Type 3 Pattern according to Grunfeld at trigger day was associated with increased serum progesterone at trigger and a decreased implantation rate, compared with type 2 EnP. The EnP at fresh or frozen ET was not associated with implantation rate, pregnancy rate, or clinical pregnancy rate

Gingold et al. 2015 Fertil Steril



Patients with Type 3 EnP at trigger day have elevated P. *Boxplot* for levels of P at trigger day, grouped by EnP at trigger day. *Boxes* display quantiles, with whiskers extending to the most extreme data point that is not >1.5 times the interquartile range. **$P<.01$.

Clinical outcomes separately divided by EnT and EnP.

Subset	Grouped by	Cycles (n)	Total ET	Total GS	Total pregs	Total CP	IR (95% CI)	PR (95% CI)	CPR (95% CI)
All	EnP at trigger								
	1	79	106	53	55	42	0.50 (0.40–0.60)	0.70 (0.58–0.79)	0.53 (0.42–0.64)
	2	138	179	97	97	82	0.54 (0.47–0.62)	0.70 (0.62–0.78)	0.59 (0.51–0.68)
	3	20	26	8	11	8	0.31 (0.14–0.52)	0.55 (0.32–0.77)	0.40 (0.19–0.64)
Fresh	EnP at transfer								
	1	1	1	0	0	0	0.00 (0.00–0.98)	0.00 (0.00–0.98)	0.00 (0.00–0.98)
	2	25	34	14	14	11	0.41 (0.25–0.59)	0.56 (0.35–0.76)	0.44 (0.24–0.65)
	3	150	205	98	99	79	0.48 (0.41–0.55)	0.66 (0.58–0.74)	0.53 (0.44–0.61)
Frozen	EnP at transfer								
	2	14	23	10	12	9	0.43 (0.23–0.66)	0.86 (0.57–0.98)	0.64 (0.35–0.87)
	3	166	213	112	126	103	0.53 (0.46–0.59)	0.76 (0.69–0.82)	0.62 (0.54–0.69)

Endometrial thickness | Triple-line pattern | **Vascularization** | Integrated evaluation

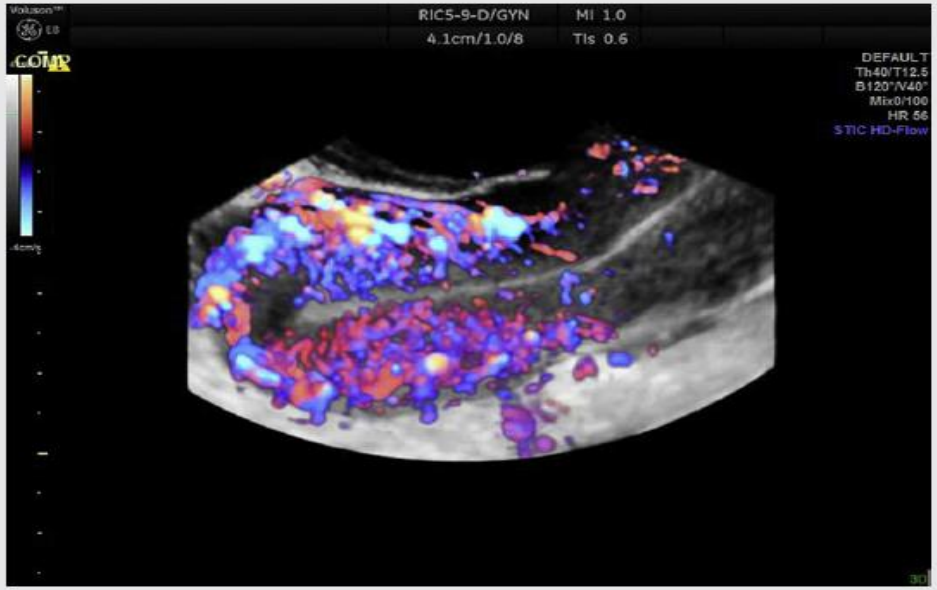
Receiver operator characteristic curve analysis revealed that the area under the curve was ~0.5 for all ultrasound parameters describing endometrial vascularization. Endometrial and subendometrial blood flows measured by 3D power Doppler ultrasound were not good predictors of pregnancy

Ng et al. 2006 Hum Reprod; Klement and Tepper 2016 Fertil Steril

Table IV. Receiver operator characteristics curve analysis of ultrasound parameters of endometrial receptivity

Test variables	Area (95% confidence interval)	
	All cycles (n = 451)	Good prognosis cycles (n = 205)
Uterine PI	0.468 (0.400, 0.535)	0.478 (0.373, 0.583)
Uterine RI	0.441 (0.373, 0.509)	0.451 (0.346, 0.556)
Endometrial thickness	0.502 (0.433, 0.571)	0.506 (0.396, 0.616)
Endometrial volume	0.489 (0.418, 0.559)	0.514 (0.400, 0.628)
Endometrial VI	0.430 (0.366, 0.494)	0.463 (0.362, 0.565)
Endometrial FI	0.484 (0.418, 0.551)	0.450 (0.347, 0.552)
Endometrial VFI	0.432 (0.368, 0.495)	0.459 (0.358, 0.560)
Subendometrial VI	0.465 (0.401, 0.529)	0.475 (0.369, 0.580)
Subendometrial FI	0.514 (0.448, 0.580)	0.463 (0.351, 0.576)
Subendometrial VFI	0.472 (0.407, 0.537)	0.477 (0.370, 0.584)

PI = pulsatility index; RI = resistance index; VI = vascularization index; FI = flow index; VFI = vascularization flow index.



Uterine sagittal plane demonstrating myometrial vascular network acquired by four-dimensional ultrasound Doppler flow.

Hershko-Klement. Ultrasound in assisted reproduction. Fertil Steril 2016.

Endometrial thickness | Triple-line pattern | Vascularization | **Integrated evaluation**

The most effective combination for evaluation of uterine receptivity was end-diastolic blood flow, endometrial pattern and endometrial thickness. Sensitivity and specificity of this combination were around 81%, positive predictive value was 68.2%, and negative predictive value 89.7%. The best sensitivity and specificity were obtained on the day of HCG administration: respectively 81.1 and 81.3%.

Dechaud 2008 Reprod Biomed Online

Table 4. Sensitivity, specificity, positive predictive value and negative predictive value of the ultrasonographic and Doppler parameters measured on the day of human chorionic gonadotrophin (HCG) injection, the day of oocyte retrieval, and the day of embryo transfer.

Ultrasonographic parameter	*Sensitivity*	*Specificity*	*PPV*	*NPV*
Day of HCG administration	81.1 (68.5–93.7)	81.3 (72.5–90.1)	68.2 (54.4–81.9)	89.7 (82.5–96.9)
Day of oocyte retrieval	29 (13–45)	94.1 (85.6–98.4)	69.2 (38.6–90.9)	74.4 (65.2–83.6)
Day of embryo transfer	73.9 (56–91.9)	51 (37–65)	41.5 (26.4–56.5)	80.6 (66.7–94.5)

Results are given with 95% confidence interval.
PPV: positive predictive value; NPV: negative predictive value.

Table 3. Sensitivity, specificity, positive predictive value and negative predictive value of the ultrasonographic and Doppler parameters measured on the day of human chorionic gonadotrophin injection (recursive-partitioning analysis).

Parameter	*Sensitivity*	*Specificity*	*PPV*	*NPV*	*TP/FP*
End-diastolic blood flow	83.8 (71.9–95.7)	62.7 (51.7–73.6)	52.5 (39.8–65.3)	88.7 (80.2–97.2)	31/28
End-diastolic blood flow + endometrial thickness[a]	83.8 (71.9–95.7)	65.3 (54.6–76.1)	54.4 (41.5–67.3)	89.1 (80.9–97.3)	31/26
End-diastolic blood flow + endometrial pattern	81.1 (68.5–93.7)	80.0 (71.0–89.1)	66.7 (52.9–80.4)	89.6 (82.2–96.9)	30/15
End-diastolic blood flow + endometrial thickness + endometrial pattern	81.1 (68.5–93.7)	81.3 (72.5–90.1)	68.2 (54.4–81.9)	89.7 (82.5–96.9)	30/14

Results are given with 95% confidence interval.
PPV: positive predictive value; NPV: negative predictive value; TP: true positive; FP: false positive.
[a]Hypothesis not selected, but reported for the reader.

Endometrial compaction

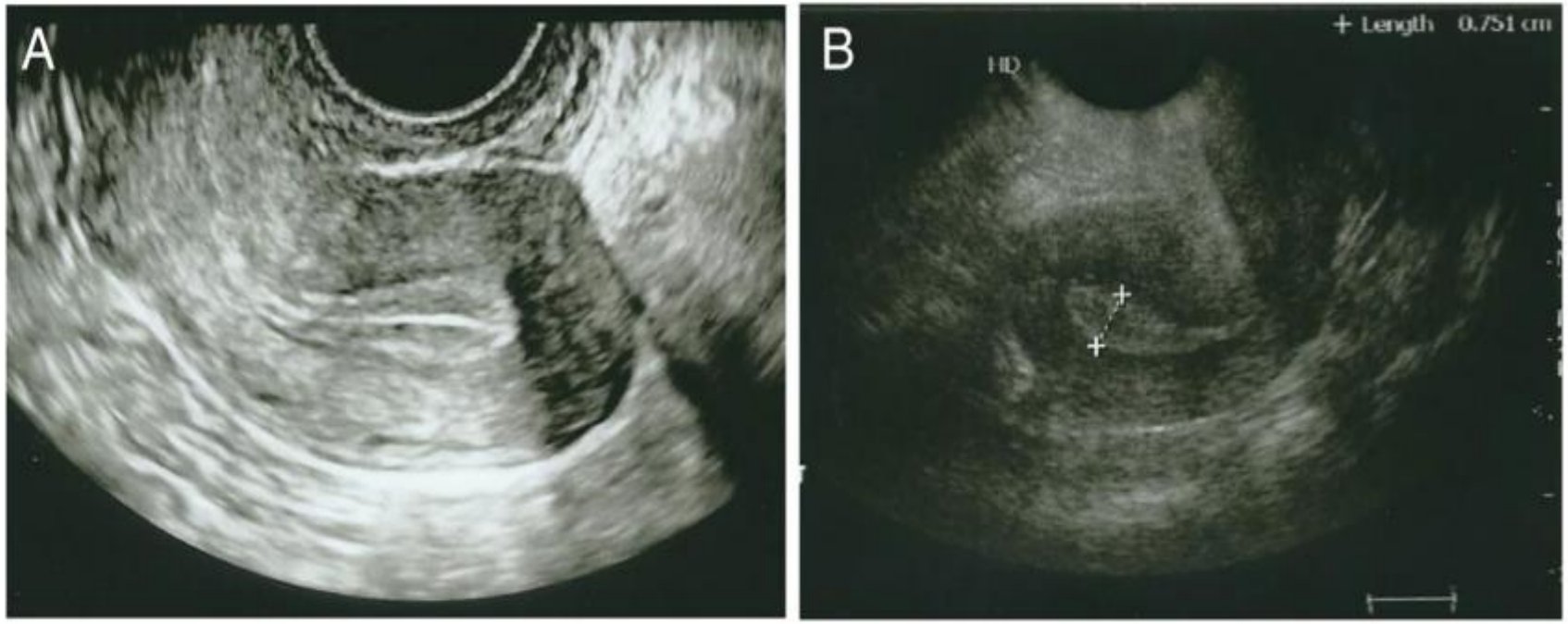


Fig. 1 **A** Pre-ovulatory trilaminar endometrium. **B** Post-ovulatory hyperechoic/homogeneous endometrium

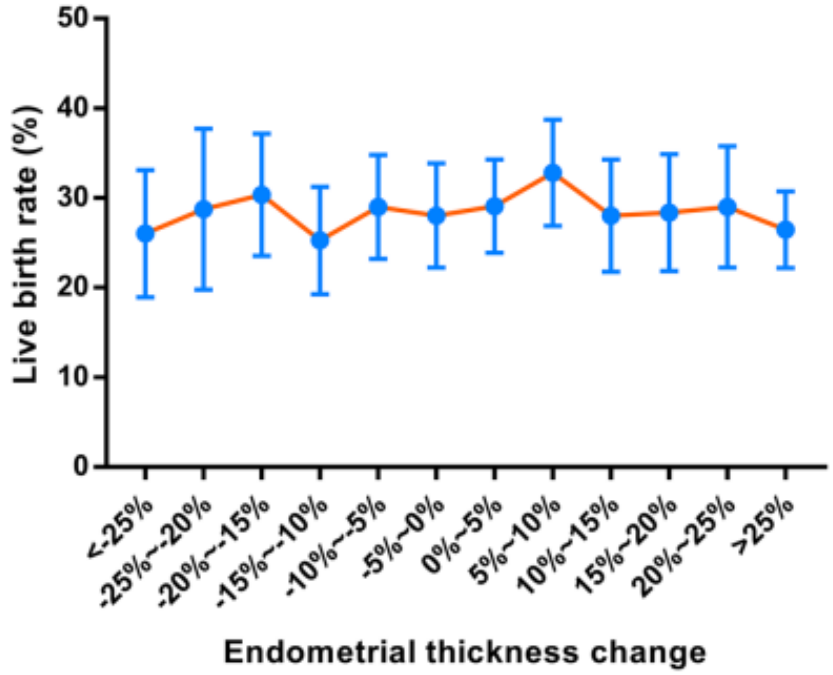
Youngster et al. 2022 JARG

Could Endometrial compaction impact on fresh embryo transfer?

Table 1. Comparison of Demographic and Clinical Characteristics Between Patients With and Without Live Birth

	No Live Birth (N = 157)	Live Birth (N = 111)	*P* Value
Age of women (y)	34.7 ± 3.1	34.0 ± 3.0	.049*
Body mass index (kg/m^2)	21.1 ± 2.4	21.1 ± 2.7	.986
Smoker	11 (7.0%)	10 (9.0%)	.646
Primary infertility	111	76	.787
Infertility duration (y)	4.4 ± 2.5	4.0 ± 2.6	.232
Cause of infertility			.592
Tubal	32 (20.4%)	23 (20.7%)	
Male	63 (40.1%)	54 (48.6%)	
Endometriosis	24 (15.3%)	12 (10.8%)	
Unexplained	16 (10.2%)	8 (7.2%)	
Mixed	22 (14.0%)	14 (12.6%)	
Intracytoplasmic sperm injection	52	39	.794
Antral follicle count	10.7 ± 7.9	11.4 ± 7.9	.505
Basal FSH level (IU/L)	8.1 ± 2.8	7.6 ± 2.1	.146
Serum estradiol level on hCG day (pmol/L)	8401 ± 4745	10156 ± 5765	.007*
Total dose of gonadotrophin (IU)	2006 ± 595	2013 ± 592	.922
Total duration of gonadotrophin (days)	10.7 ± 2.2	10.9 ± 2.6	.353
No. of oocytes aspirated	9.4 ± 5.7	10.2 ± 5.4	.237
Endometrial thickness on hCG day (mm)	13.0 ± 3.0	13.0 ± 2.8	.929
Endometrial thickness on ET day (mm)	13.8 ± 3.1	13.9 ± 3.2	.879
Endometrial volume on hCG day (ml)	6.4 ± 2.9	6.7 ± 2.9	.508
Endometrial volume on ET day (ml)	5.5 ± 2.5	5.6 ± 2.7	.635

*P values < .05 and was considered statistically significant. Values expressed mean ± SD or number (%).
ET indicates embryo transfer; hCG, human chorionic gonadotrophin.



Endometrial compaction between trigger and day of ET does not provide signifcant prognostic information for pregnancy outcome in fresh IVF/ICSI cycles

Lam et al. 2021 J Ultrasound med; Huang et al. 2021 Archives in Obst and Gyne

Could Endometrial compaction impact on frozen embryo transfer?

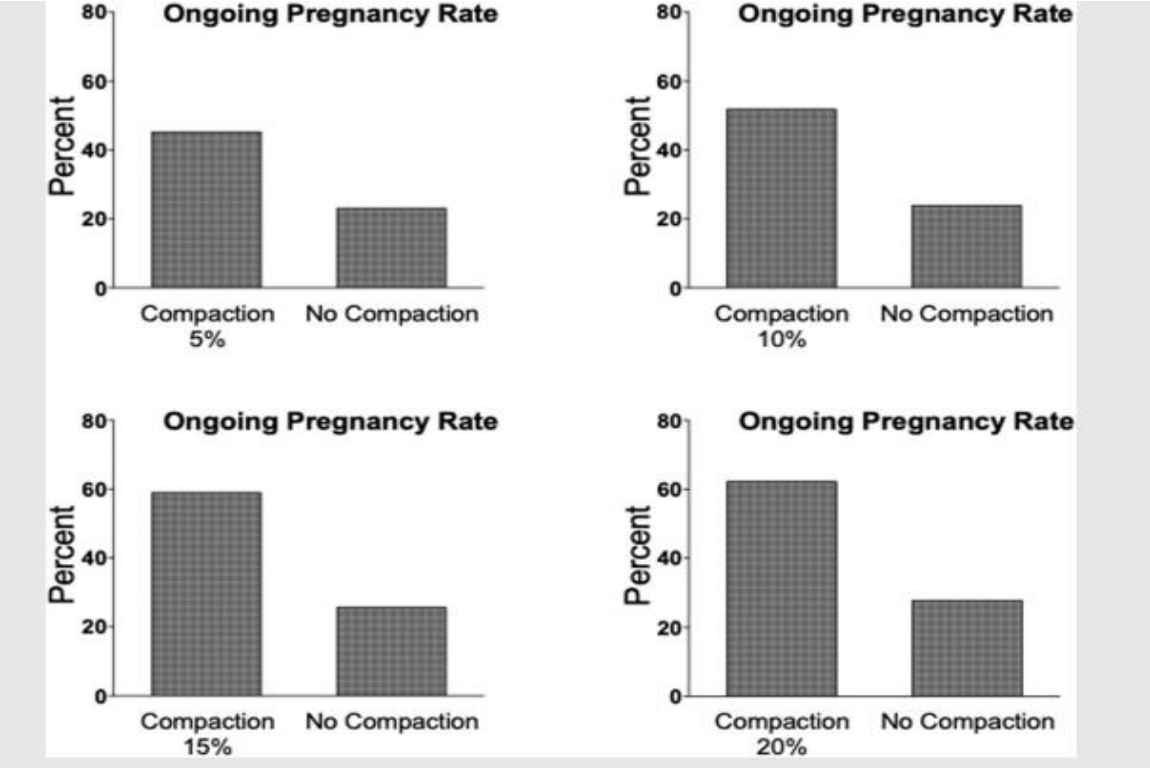


Table 2 Live birth, clinical pregnancy, and SAB rates: any compaction vs. no change vs. any expansion

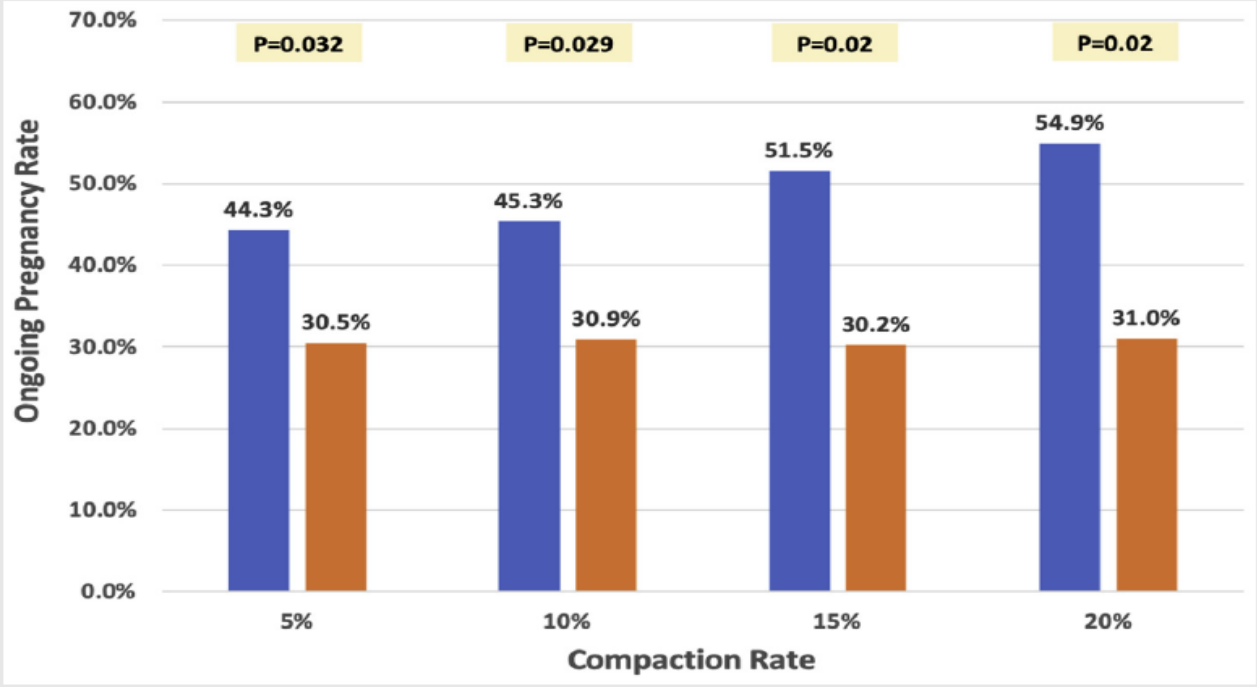
	Any compaction[b] ($n = 43$)	No change[c] ($n = 64$)	Any expansion[d] ($n = 152$)	p value[f]
LBR, n (%)	25/43 (58.1)	35/64 (54.7)	89/152 (56.6)	0.96
CPR, n (%)	27/43 (62.8)	46/64 (71.9)	103/152 (67.8)	0.61
SAB rate[a], n (%)	1/27 (3.7)	8/46 (17.4)	9/101[e] (8.9)	0.13

Contradictory data concerning the impact of endometrial compaction between the end of estradiol phase and FET outcome of unselected embryos

Haas et al. 2019 Fertil Steril; Riestenberg et al. 2021 JARG

Could Endometrial compaction impact on euploid frozen embryo transfer?

FIGURE 1



Ongoing pregnancy rate by percentage of compaction.

Zilberberg. Endometrial compaction euploid embryos. Fertil Steril 2020.

Endometrial compaction between the end of estradiol phase and ET could have a correlation with ongoing pregnancy rate in FET cycles of euploid embryos

Zilberberg et al. 2020 Fertil Steril

Frozen embryo transfer

Is there a specific endometrial pattern that could correlate with embryo implantation and indicate to postpone ET?

- Endometrial thickness
- “Triple line” pattern
- Vascularization
- Integrated evaluation

May we consider FET (cycle segmentation) as more efficient procedure in all IVF cycles?

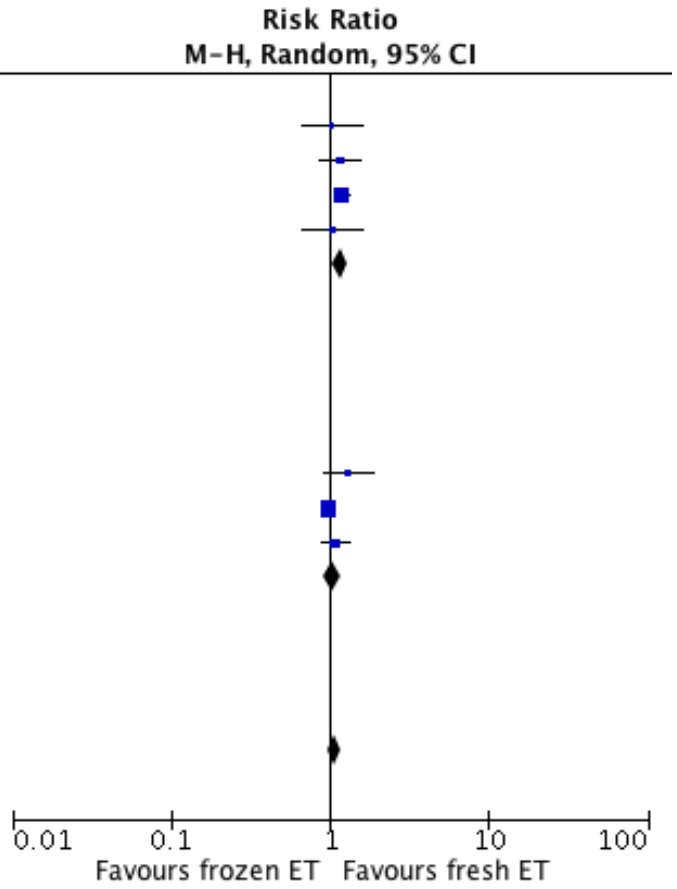
- Reduced risk of OHSS
- Less detrimental effect related to ovarian stimulation
- Potentially better clinical outcome?
- Better neonatal and perinatal outcome?

Fresh transfer VS Frozen transfer

- Reduced risk of OHSS
- Less detrimental effect related to ovarian stimulation
- Potentially better clinical outcome?
- Better neonatal and perinatal outcome?

FET: Higher live birth in hyper-responder and PCOS women

Study or Subgroup	Frozen ET Events	Frozen ET Total	Fresh ET Events	Fresh ET Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
1.7.1 Live Birth Rate - PCOS / Hyper Responder							
Ferraretti 1999	23	58	26	67	4.1%	1.02 [0.66, 1.58]	1999
Shapiro 2011b	37	60	33	62	7.6%	1.16 [0.85, 1.57]	2011
Chen 2016	368	746	320	762	28.9%	1.17 [1.05, 1.31]	2016
Aflatoonian 2018	33	140	32	140	4.3%	1.03 [0.67, 1.58]	2018
Subtotal (95% CI)		**1004**		**1031**	**44.9%**	**1.16 [1.05, 1.28]**	
Total events	461		411				
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.67$, df = 3 (P = 0.88); $I^2 = 0\%$							
Test for overall effect: Z = 2.89 (P = 0.004)							
1.7.2 Live Birth Rate - No-PCOS / Normo Responder							
Shapiro 2011a	37	70	27	67	5.6%	1.31 [0.91, 1.89]	2011
Shi 2018	525	1077	542	1080	34.8%	0.97 [0.89, 1.06]	2018
Vuong 2018	132	391	123	391	14.7%	1.07 [0.88, 1.31]	2018
Subtotal (95% CI)		**1538**		**1538**	**55.1%**	**1.03 [0.91, 1.17]**	
Total events	694		692				
Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 3.04$, df = 2 (P = 0.22); $I^2 = 34\%$							
Test for overall effect: Z = 0.47 (P = 0.64)							
Total (95% CI)		**2542**		**2569**	**100.0%**	**1.08 [0.98, 1.18]**	
Total events	1155		1103				
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 9.00$, df = 6 (P = 0.17); $I^2 = 33\%$							
Test for overall effect: Z = 1.61 (P = 0.11)							
Test for subgroup differences: $Chi^2 = 1.95$, df = 1 (P = 0.16), $I^2 = 48.7\%$							



Roque et al. 2019 Hum Reprod Update

Fresh versus elective frozen embryo transfer in IVF/ICSI cycles: a systematic review and meta-analysis of reproductive outcomes

Matheus Roque [1,2,*†], Thor Haahr [3,†], Selmo Geber[2,4], Sandro C. Esteves [3,5,6], and Peter Humaidan[3,5]

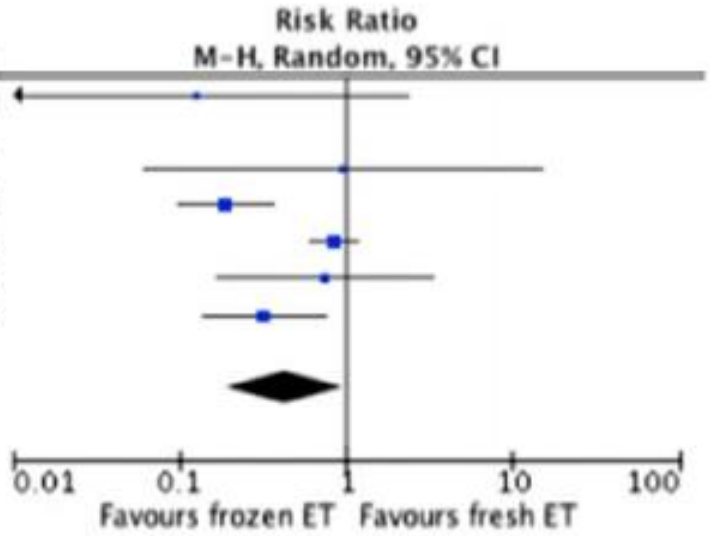
The risk of moderate/severe OHSS was significantly lower with eFET than with fresh embryo transfer (RR = 0.42; 95% CI: 0.19–0.96)

(c)

Study or Subgroup	Frozen ET Events	Total	Fresh ET Events	Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
Ferraretti 1999	0	58	4	67	6.2%	0.13 [0.01, 2.33]	1999
Shapiro 2011b	0	60	0	62		Not estimable	2011
Shapiro 2011a	1	70	1	67	6.7%	0.96 [0.06, 14.99]	2011
Chen 2016	10	746	54	762	23.8%	0.19 [0.10, 0.37]	2016
Aflatoonian 2018	43	140	51	140	27.0%	0.84 [0.61, 1.17]	2018
Vuong 2018	3	391	4	391	14.6%	0.75 [0.17, 3.33]	2018
Shi 2018	7	1077	22	1080	21.7%	0.32 [0.14, 0.74]	2018
Total (95% CI)		**2542**		**2569**	**100.0%**	**0.42 [0.19, 0.96]**	
Total events	64		136				

Heterogeneity: $Tau^2 = 0.62$; $Chi^2 = 21.01$, df = 5 (P = 0.0008); $I^2 = 76\%$

Test for overall effect: Z = 2.06 (P = 0.04)



Roque et al. 2019 Hum Reprod Update

The NEW ENGLAND JOURNAL of MEDICINE

IVF Transfer of Fresh or Frozen Embryos in Women without Polycystic Ovaries

Lan N. Vuong, M.D., Ph.D., Vinh Q. Dang, M.D., Tuong M. Ho, M.D., Bao G. Huynh, M.Sc., Duc T. Ha, M.D., Toan D. Pham, B.Sc., Linh K. Nguyen, M.D., Robert J. Norman, M.D., and Ben W. Mol, M.D., Ph.D.

METHODS

782 infertile women without the polycystic ovary syndrome who were undergoing a first or second IVF cycle to receive **either a frozen embryo or a fresh embryo on day 3**. In the frozen-embryo group, all grade 1 and 2 embryos had been cryopreserved, and a **maximum of two embryos were thawed** on the day of transfer in the following cycle. In the fresh-embryo group, a **maximum of two fresh embryos** were transferred in the stimulated cycle

ENDPOINT

The primary outcome was ongoing pregnancy (pregnancy with a detectable heart rate after 12 weeks of gestation) after the first embryo transfer.

Vuong et al. 2018 N Engl J Med

Comparable ongoing pregnancy rate and live birth rate between groups

Table 2. Fertility Outcomes and Treatment Complications after the First Embryo Transfer.*

Variable	Frozen-Embryo Group (N=391)	Fresh-Embryo Group (N=391)	Between-Group Difference *percentage points (95% CI)*	Risk Ratio (95% CI)†	P Value‡
Fertility outcome					
Ongoing pregnancy — no. (%)§	142 (36.3)	135 (34.5)	1.8 (–5.2 to 8.7)	1.05 (0.87 to 1.27)	0.65
Singleton	96 (24.6)	92 (23.5)	1.0 (–5.2 to 7.3)	1.04 (0.81 to 1.34)	0.80
Twins	46 (11.8)	43 (11.0)	0.8 (–3.9 to 5.5)	1.07 (0.72 to 1.58)	0.82
Implantation — no./total no. (%)	224/780 (28.7)	210/778 (27.0)	1.7 (–2.9 to 6.3)	1.06 (0.91 to 1.25)	0.46
Clinical pregnancy — no. (%)	173 (44.2)	163 (41.7)	2.5 (–4.6 to 9.8)	1.06 (0.90 to 1.25)	0.52
Multiple pregnancy — no. (%)	46 (11.8)	45 (11.5)	0.3 (–4.5 to 5.0)	1.02 (0.69 to 1.50)	1.00
Ectopic pregnancy — no. (%)	6 (1.5)	13 (3.3)	–1.8 (–4.2 to 0.6)	0.46 (0.18 to 1.2)	0.16
Miscarriage — no. (%)	25 (6.4)	15 (3.8)	2.6 (–0.8 to 5.9)	1.67 (0.89 to 3.11)	0.14
Live birth — no. (%)§	132 (33.8)	123 (31.5)	2.3 (–4.5 to 9.1)	1.07 (0.88 to 1.31)	0.54
Singleton	97 (24.8)	95 (24.3)	0.5 (–5.8 to 6.8)	1.02 (0.80 to 1.31)	0.93
Boys	57 (14.6)	47 (12.0)	2.6 (–2.5 to 7.6)	1.21 (0.85 to 1.74)	0.34
Girls	40 (10.2)	48 (12.3)	–2.1 (–6.7 to 2.6)	0.83 (0.56 to 1.24)	0.43
Twins	35 (9.0)	28 (7.2)	1.8 (–2.3 to 5.9)	1.25 (0.78 to 2.01)	0.43
Treatment complication					
Moderate or severe ovarian hyperstimulation syndrome — no. (%)	3 (0.8)	4 (1.0)	–0.3 (–1.8 to –1.3)	0.75 (0.17 to 3.33)	0.99
Maternal death — no. (%)	0	0			

* CI denotes confidence interval.
† The risk ratios are for the frozen-embryo group as compared with the fresh-embryo group.
‡ P values were calculated by means of Fisher's exact test and Student's t-test.
§ The analysis of rates of ongoing pregnancy and live birth in singletons and twins was performed post hoc.

Vuong et al. 2018 N Engl J Med

Frozen versus fresh single blastocyst transfer in ovulatory women: a multicentre, randomised controlled trial

Daimin Wei, Jia-Yin Liu*, Yun Sun*, Yuhua Shi*, Bo Zhang*, Jian-Qiao Liu, Jichun Tan, Xiaoyan Liang, Yunxia Cao, Ze Wang, Yingying Qin, Han Zhao, Yi Zhou, Haiqin Ren, Guimin Hao, Xiufeng Ling, Junzhao Zhao, Yunshan Zhang, Xiujuan Qi, Lin Zhang, Xiaohui Deng, Xiaoli Chen, Yimin Zhu, Xiaohong Wang, Li-Feng Tian, Qun Lv, Xiang Ma, Heping Zhang, Richard S Legro, Zi-Jiang Chen*

METHODS

This multicentre, non-blinded, randomised controlled trial was undertaken in 21 academic fertility centres in China - 1650 women with regular menstrual cycles undergoing their first cycle of in-vitro fertilisation were enrolled from Aug 1, 2016, to June 3, 2017**. Eligible women were randomly assigned to either fresh or frozen single blastocyst transfer**

ENDPOINT

The primary outcome was singleton livebirth rate. Analysis was by intention to treat.

Wei et al. 2019 The Lancet

Significantly higher liver birh rate in women who underwent frozen embryo transfer

	Frozen embryo transfer group (n=825)	Fresh embryo transfer group (n=825)	Relative risk in frozen embryo group (95% CI)	p value
Livebirth				
Singleton livebirth per woman	416 (50·4%)	329 (39·9%)	1·26 (1·14–1·41)	<0·0001
Twin livebirth per woman	23 (2·8%)	12 (1·5%)	1·92 (0·96–3·83)	0·0602
Total livebirth per woman	439 (53·2%)	341 (41·3%)	1·29 (1·16–1·43)	<0·0001
Birthweight*				
Singleton (g)	3407·9 (476·2)†	3293·1 (513·5)	..	0·0018
Twin (g)	2544·8 (468·9)	2523·8 (472·7)	..	0·86
Gestational weeks (week)	38·9 (1·7)	38·8 (1·9)	..	0·41
Pregnancy				
Conception per woman‡	583 (70·7%)	481 (58·3%)	1·21 (1·13–1·30)	<0·0001
Clinical pregnancy per woman§	512 (62·1%)	401 (48·6%)	1·28 (1·17–1·39)	<0·0001
Singleton pregnancy	491 (59·5%)	395 (47·9%)	1·24 (1·14–1·36)	<0·0001
Twin pregnancies¶	21 (2·5%)	6 (0·7%)	3·50 (1·42–8·63)	0·0036
Monozygotic twin pregnancies‖	19 (2·3%)	14 (1·7%)	1·36 (0·69–2·69)	0·38
Implantation per embryo**	524/838 (62·5%)	406/833 (48·7%)	1·28 (1·18–1·40)	<0·0001
Ongoing pregnancy per woman††	458 (55·5%)	355 (43·0%)	1·29 (1·17–1·43)	<0·0001
Pregnancy loss				
Total pregnancy loss among conception	134/583 (23·0%)	124/481 (25·8%)	0·89 (0·72–1·10)	0·29
Biochemical miscarriage	65/583 (11·1%)	68/481 (14·1%)	0·79 (0·57–1·08)	0·14
Clinical pregnancy loss	69/512 (13·5%)	56/401 (14·0%)	0·97 (0·70–1·34)	0·83
First trimester pregnancy loss	54/512 (10·5%)	46/401 (11·5%)	0·92 (0·63–1·33)	0·66
Second trimester pregnancy loss	15/512 (2·9%)	10/401 (2·5%)	1·17 (0·53–2·59)	0·69

Wei et al. 2019 The Lancet

Fresh transfer VS Frozen transfer

- Reduced risk of OHSS
- Less detrimental effect related to ovarian stimulation
- Potentially better clinical outcome?
- Better neonatal and perinatal outcome?

Uterine artery Doppler in singleton pregnancies conceived after *in-vitro* fertilization or intracytoplasmic sperm injection with fresh *vs* frozen blastocyst transfer: longitudinal cohort study

P. I. CAVORETTO[1], A. FARINA[2], G. GAETA[1], C. SIGISMONDI[1], S. SPINILLO[1], D. CASIERO[1], M. POZZONI[1], P. VIGANO[1], E. PAPALEO[1] and M. CANDIANI[1]

METHODS

This was a prospective longitudinal study of viable singleton IVF/ICSI pregnancies conceived after FBT or fresh blastocyst transfer. Pregnant women underwent ultrasound assessment at 7–10, 11–14, 18–25 and 26–37weeks' gestation. Mean UtA-PI was measured using Doppler ultrasound according to The Fetal Medicine Foundation criteria

ENDPOINT

The primary outcome was mean UtA-PImeasurement and secondary outcomes were gestationalage at birth, birth weight and fetal and maternalcomplications, including small-for-gestational age (SGA),pre-eclampsia and large-for-gestational age

Cavoretto et al. 2022 Ultrasound Obstet Gynecol

UtA-PI and the proportion of SGA are lower in IVF/ICSI pregnancies conceived after FBT as compared to fresh blastocyst transfer

Variable	*Fresh blastocysts (n = 164)*	*Frozen blastocysts (n = 203)*	P
Primary outcome			
UtA-PI MoM	1.00 ± 0.29	0.86 ± 0.28	< 0.001
Secondary outcome			
Small-for-gestational age	13 (7.9)	4 (2.0)	0.008
Large-for-gestational age	4 (2.4)	8 (3.9)	0.421
Pre-eclampsia	8 (4.9)	3 (1.5)	0.065
Gestational diabetes mellitus	12 (7.3)	17 (8.4)	0.698
Gestational age at delivery (days)	272 (265–279)	274 (267–281)	0.370
Preterm birth < 37 weeks	19 (11.6)	13 (6.4)	0.117
Preterm birth < 34 weeks	5 (3.0)	7 (3.4)	0.830
Birth weight (g)	3051 ± 575	3262 ± 542	< 0.001
Birth-weight centile	43.4 ± 23.3	50.0 ± 23.1	0.007
Birth-weight Z-score	−0.22 ± 0.78	0.05 ± 0.88	0.002

Data are given as mean ± SD, *n* (%) or median (interquartile range). *P*-values calculated using *t*-test or χ^2 test, as appropriate. MoM, multiples of the median; UtA-PI, mean of left and right uterine artery pulsatility index.

Cavoretto et al. 2022 Ultrasound Obstet Gynecol

Significantly reduced risk of preterm birth and SGA babies in frozen vs fresh embryo transfer

Study or Subgroup	Cryopreserved Events	Total	Fresh Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Bakkensen et al. 2019	56	600	62	465	6.2%	0.67 [0.46, 0.98]
Barsky et al. 2016	10	109	25	289	1.9%	1.07 [0.49, 2.30]
Cavoretto et al. 2020	13	203	19	164	2.0%	0.52 [0.25, 1.09]
De Vos et al. 2018	2	58	21	218	0.5%	0.34 [0.08, 1.47]
Feng et al. 2012	14	142	25	252	2.3%	0.99 [0.50, 1.98]
Ginström et al. 2019	271	3650	398	4469	16.7%	0.82 [0.70, 0.96]
Ishihara et al. 2014	1656	27408	403	5981	20.4%	0.89 [0.80, 1.00]
Korosec et al. 2016	19	211	111	916	3.9%	0.72 [0.43, 1.20]
Li et al. 2014	580	6708	1254	12241	21.2%	0.83 [0.75, 0.92]
Ozgur et al. 2015	21	116	35	176	3.0%	0.89 [0.49, 1.62]
Pereira et al. 2016	40	427	28	334	4.0%	1.13 [0.68, 1.87]
Reljič et al. 2019	12	85	11	126	1.5%	1.72 [0.72, 4.10]
Sekhon et al. 2018	24	100	25	99	2.6%	0.93 [0.49, 1.78]
Shavit et al. 2017	20	161	78	575	3.7%	0.90 [0.53, 1.53]
Shi et al. 2019	180	2033	79	1220	9.9%	1.40 [1.07, 1.85]
Total (95% CI)		**42011**		**27525**	**100.0%**	**0.89 [0.80, 0.99]**
Total events	2918		2574			

Heterogeneity: Tau² = 0.01; Chi² = 22.77, df = 14 (P = 0.06); I² = 39%
Test for overall effect: Z = 2.05 (P = 0.04)

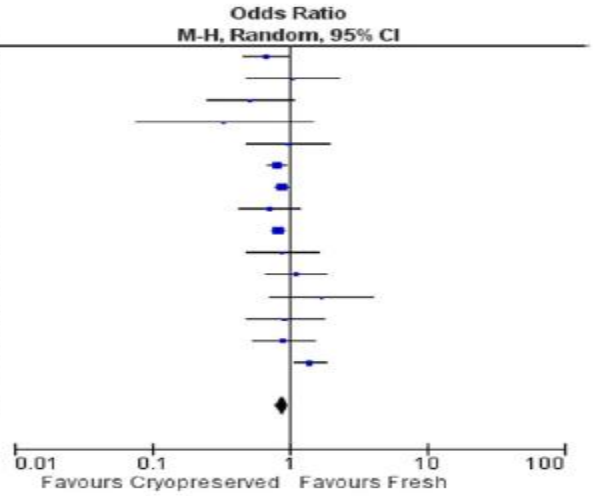


FIGURE 2 Forest plots for preterm births comparing cryopreserved versus fresh blastocyst transfer.

Study or Subgroup	Cryopreserved Events	Total	Fresh Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Bakkensen et al. 2019	37	600	46	465	3.8%	0.60 [0.38, 0.94]
Cavoretto et al. 2020	4	203	13	164	0.6%	0.23 [0.07, 0.73]
Galliano et al. 2015	12	68	8	68	0.9%	1.61 [0.61, 4.22]
Ginström et al. 2019	92	3650	198	4469	11.3%	0.56 [0.43, 0.72]
Hiura et al. 2017	3	64	1	16	0.1%	0.74 [0.07, 7.60]
Ishihara et al. 2014	1041	27408	357	5981	34.0%	0.62 [0.55, 0.70]
Li et al. 2014	413	6708	1277	12241	37.2%	0.56 [0.50, 0.63]
Reljič et al. 2019	4	85	4	126	0.4%	1.51 [0.37, 6.19]
Shavit et al. 2017	9	161	47	575	1.5%	0.67 [0.32, 1.39]
Shi et al. 2019	119	2033	115	1220	10.2%	0.60 [0.46, 0.78]
Total (95% CI)		**40980**		**25325**	**100.0%**	**0.59 [0.54, 0.65]**
Total events	1734		2066			

Heterogeneity: Tau² = 0.00; Chi² = 10.04, df = 9 (P = 0.35); I² = 10%
Test for overall effect: Z = 11.39 (P < 0.00001)

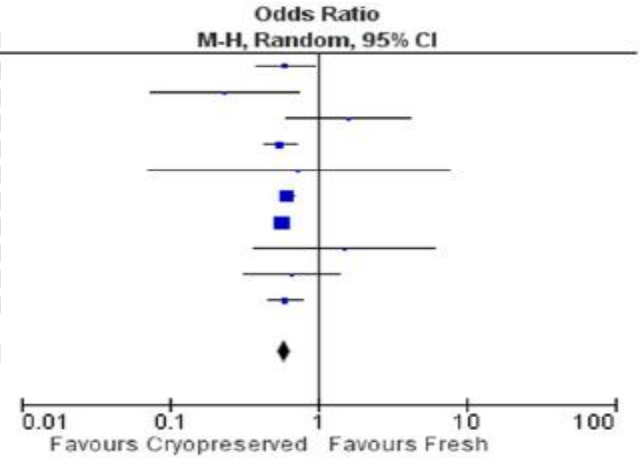


FIGURE 4 Forest plots for small for gestational age comparing cryopreserved versus fresh blastocyst transfer.

Conforti, Alviggi et al. 2021 Reprod Biomed Online

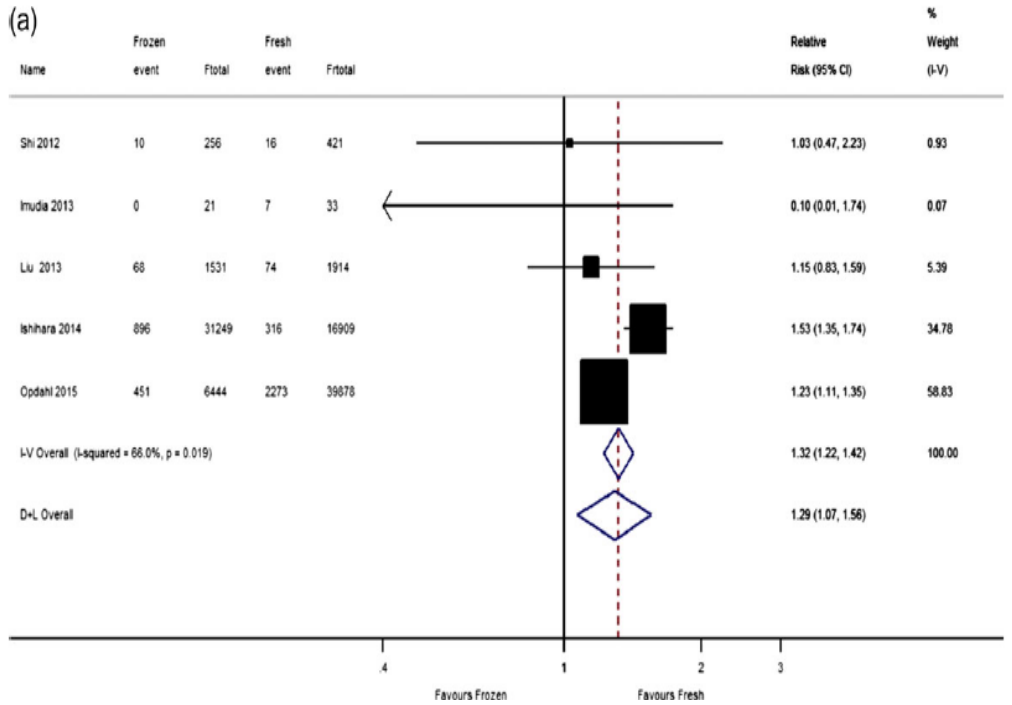
Significantly increased risk of pre-eclampsia in pregnancy after frozen vs fresh embryo transfer

	Frozen embryo transfer group	Fresh embryo transfer group	Relative risk in frozen embryo group (95% CI)	p value
Maternal complications				
Moderate or severe OHSS*	4/825 (0·5%)	9/825 (1·1%)	0·44 (0·14–1·44)	0·16
Ectopic pregnancy†	6/583 (1·0%)	12/481 (2·5%)	0·41 (0·16–1·09)	0·065
Gestational diabetes‡	52/512 (10·2%)	32/401 (8·0%)	1·27 (0·84–1·94)	0·26
Gestational hypertension‡	13/512 (2·5%)	8/401 (2·0%)	1·27 (0·53–3·04)	0·59
Pre-eclampsia‡	16/512 (3·1%)	4/401 (1·0%)	3·13 (1·06–9·30)	0·029
Placenta previa‡	8/512 (1·6%)	5/401 (1·2%)	1·25 (0·41–3·80)	0·69
Preterm rupture of membrane‡	49/512 (9·6%)	44/401 (11·0%)	0·87 (0·59–1·28)	0·49
Preterm delivery‡	32/512 (6·3%)	26/401 (6·5%)	0·96 (0·58–1·59)	0·89
Post-partum haemorrhage§	8/441 (1·8%)	1/342 (0·3%)	6·20 (0·78–49·37)	0·09
Neonatal complications				
Small for gestational age¶	29/452 (6·4%)	33/353 (9·3%)	0·69 (0·43–1·11)	0·12
Large for gestational age¶	84/452 (18·6%)	41/353 (11·6%)	1·60 (1·13–2·26)	0·0067
Neonatal hospitalisation >3 days‖	50/443 (11·3%)	30/347 (8·6%)	1·31 (0·85–2·01)	0·22
Neonatal jaundice among live newborns‖	79/443 (17·8%)	58/347 (16·7%)	1·07 (0·78–1·45)	0·68
Neonatal infection among live newborns‖	15/443 (3·4%)	10/347 (2·9%)	1·17 (0·53–2·58)	0·69
Congenital anomalies**	12/464 (2·6%)	11/355 (3·1%)	0·83 (0·37–1·87)	0·66

Data are n/N (%). OHSS=ovarian hyperstimulation syndrome. *The denominator was number of women randomly assigned to each group. †The denominator was number of conception in each group. ‡The denominator was number of clinical pregnancy in each group. §The denominator was number of delivery including livebirths and stillbirths. ¶The denominator was number of newborn babies in each group. Birthweight of ten newborn babies in the frozen embryo transfer group was missing. ‖The denominator was number of newborn babies in each group. A total of 19 newborn babies in the frozen embryo transfer group and six in the fresh embryo transfer group were lost to follow-up. **The denominator was number of live newborns plus number of stillborn babies.

Table 4: **Maternal and neonatal complications**

This study does not distinguish twin vs singleton pregnancy



Favour frozen Favour fresh

This meta-analysis does not distinguish between day 3 or day 5 ET

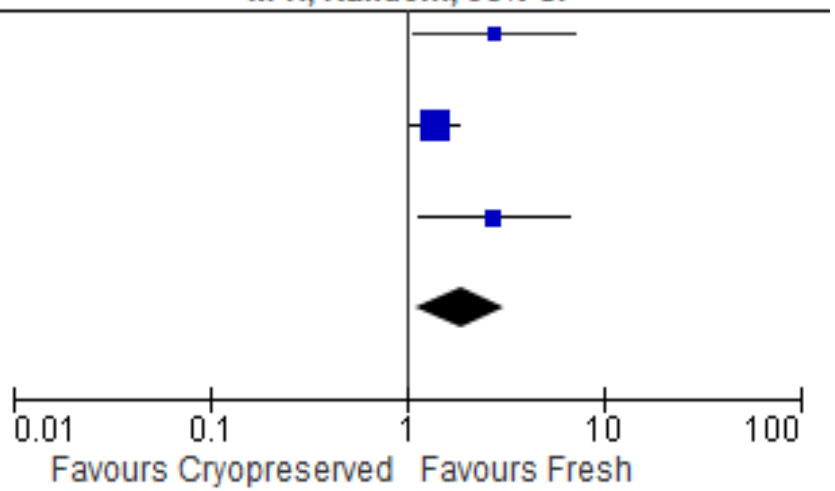
Wei et al. 2019 The Lancet; Maheshwari et al. 2014 Hum Reprod Update

However excluding studies with higher risk of bias we observed a positive relationship between FET and preeclampsia

Study or Subgroup	Cryopreserved Events	Cryopreserved Total	Fresh Events	Fresh Total	Weight	Odds Ratio M-H, Random, 95% CI
Barsky et al. 2016	9	109	9	289	20.9%	2.80 [1.08, 7.25]
Cavoretto et al. 2020	3	203	8	164	0.0%	0.29 [0.08, 1.12]
Ginström et al. 2016	87	1793	107	3026	55.9%	1.39 [1.04, 1.86]
Reljič et al. 2019	1	85	3	126	0.0%	0.49 [0.05, 4.77]
Shavit et al. 2017	9	161	12	575	23.1%	2.78 [1.15, 6.72]
Total (95% CI)		**2063**		**3890**	**100.0%**	**1.89 [1.12, 3.19]**
Total events	105		128			

Heterogeneity: Tau² = 0.11; Chi² = 3.70, df = 2 (P = 0.16); I² = 46%

Test for overall effect: Z = 2.38 (P = 0.02)



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Population or Sample: Singleton (*n* = 4636) and twin (*n* = 544) live births after NC-FET (*n* = 776), SC-FET (*n* =758) or HRC-FET (*n* = 3646) registered from 2014 to 2019 Swiss IVF Registry.

TABLE 2 Pregnancy outcome of singletons (*n* = 4636) in frozen embryo transfers (FET) by cycle regimen

Outcomes	Deliveries (*n* = 4636)			Multivariate analysis					
	Incidence (%)			HRC-FET vs. NC-FET		HRC-FET vs. SC-FET		SC-FET vs. NC-FET	
Pregnancy pathology (%)	NC-FET (*n* = 703), *n* (%)	SC-FET (*n* = 662), *n* (%)	HRC-FET (*n* = 3271), *n* (%)	Adjusted OR (95% CI)	*p* value	Adjusted OR (95% CI)	*p* value	Adjusted OR (95% CI)	*p* value
Bleeding in first trimester	20 (2.8)	17 (2.6)	230 (7.0)	2.23 (1.33–3.75)	*0.003*	2.08 (1.03–4.21)	0.042	1.07 (0.47–2.45)	0.870
Bleeding in second trimester	5 (0.7)	6 (0.9)	39 (1.2)	2.09 (0.77–5.69)	0.150	1.42 (0.46–4.40)	0.543	1.47 (0.35–6.11)	0.596
Bleeding in third trimester	9 (1.3)	6 (0.9)	24 (0.7)	0.55 (0.23–1.30)	0.173	1.18 (0.38–3.65)	0.779	0.46 (0.13–1.61)	0.227
Premature labour in second trimester	6 (0.9)	1 (0.2)	28 (0.9)	n.a.	–	n.a.	–	n.a.	–
Premature labour in third trimester	11 (1.6)	2 (0.3)	37 (1.1)	n.a.	–	n.a.	–	n.a.	–
Premature rupture of membranes	10 (1.4)	9 (1.4)	101 (3.1)	1.20 (0.56–2.54)	0.643	1.07 (0.40–2.82)	0.898	1.12 (0.36–3.52)	0.845
Placenta praevia	8 (1.1)	6 (0.9)	32 (1.0)	0.94 (0.40–2.22)	0.888	1.30 (0.43–3.93)	0.647	0.73 (0.20–2.60)	0.622
Isolated hypertension >140/90 mmHg	6 (0.9)	1 (0.2)	60 (1.8)	2.50 (1.02–6.12)	*0.045*	1.30 (0.43–3.93)	0.647	0.38 (0.04–3.48)	0.391
Pre-eclampsia	12 (1.7)	2 (0.3)	93 (2.8)	2.16 (1.13–4.12)	*0.019*	6.02 (1.38–26.24)	*0.017*	0.36 (0.07–1.74)	0.203
Eclampsia	2 (0.3)	9 (1.4)	5 (0.2)	n.a.	–	n.a.	–	n.a.	–
Intrauterine growth restriction	13 (1.8)	1 (0.2)	42 (1.3)	n.a.	–	n.a.	–	n.a.	–
Gestational diabetes	32 (4.6)	46 (6.9)	147 (4.5)	0.96 (0.61–1.52)	0.873	0.51 (0.30–0.88)	*0.016*	1.88 (0.99–3.57)	0.053
Cervical insufficiency with cerclage	1 (0.1)	5 (0.8)	8 (0.2)	1.93 (0.22–17.03)	0.554	0.52 (0.12–2.21)	0.374	3.73 (0.34–41.35)	0.283
Hospitalisation in pregnancy	15 (2.1)	24 (3.6)	97 (3.0)	1.62 (0.88–2.97)	0.119	1.26 (0.65–2.44)	0.497	1.29 (0.57–2.93)	0.545
Cholestasis	1 (0.1)	0 (0)	8 (0.2)	n.a.	–	n.a.	–	n.a.	–
Unknown	0	1 (0.2)	4 (0.1)	n.a.	–	n.a.	–	n.a.	–
Other	337 (47.9)	278 (42.0)	931 (28.5)	0.39 (0.32–0.48)	*<0.001*	0.24 (0.18–2.19)	*<0.001*	1.60 (1.18–2.19)	*0.003*

Italic values indicate significance of $p < 0.05$.

Highest maternal risks of pre-eclampsia disorders in HRC-FET

Pape, Levy and von Wolff 2022 BJOG

The endometrium during COH: What ongoing parameters are indicating to postpone embryo transfer?

CONCLUSIONS

Increasing body of evidence (large IVF cohort study from CARTR Plus, involving almost 100,000 transfers) indicates that fresh cycles LBR increases to an endometrial thickness of 10-12 mm. Conversely, an endometrial thickness <6 mm seems to be associated with a reduction in LBR in both fresh and frozen transfers.

Current lines of evidence do not support any specific thickness measurement above which pregnancy outcomes worsen

Despite endometrial thickness and patterns during fresh cycles seem to correlate with pregnancy outcomes, no clear raccomandations on postponing embryo transfer are provided

There is no sufficient evidence concerning relationship between endometrial vascularization and outcome of IVF

The clinical relevance of elective FET (cycle segmentation) is still matter of debate and more RCT are required

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