

· 专题研究:妇产科疾病 ·

宫腔内人工授精周期子宫内膜厚度对妊娠结局的影响分析

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[摘要] 目的:探讨宫腔内夫精人工授精(intrauterine insemination, IUI)周期子宫内膜厚度与临床妊娠结局的相关性。方法:回顾性分析2016—2022年南京鼓楼医院生殖医学中心行夫精IUI的4 764个周期,根据人绒毛膜促性腺激素(human chorionic gonadotropin, hCG)诱导排卵当日经阴道超声监测的不同子宫内膜厚度,将IUI周期分内膜厚度 < 8 mm组($n=395$ 例)和内膜厚度 ≥ 8 mm组($n=4 369$ 例),分析不同子宫内膜厚度IUI周期临床妊娠结局差异。采用倾向评分匹配法进行二次分析以控制混杂变量影响,采用单因素和多因素 Logistic 回归分析,评估子宫内膜厚度对临床妊娠结局的影响。结果:两组患者体重指数(body mass index, BMI)、基础卵泡刺激素、不孕年限、IUI周期数、IUI周期方案、IUI次数、前向运动(progressive motility, PR)精子总数比较差异均无统计学意义($P > 0.05$)。两组患者不孕类型比较差异有统计学意义($P < 0.05$)。与内膜厚度 < 8 mm组相比,内膜厚度 ≥ 8 mm组的患者(女方及男方)平均年龄更低,患者抗缪勒氏激素(anti-Müllerian hormone, AMH)、窦卵泡计数(antral follicle count, AFC)也显著更高(P 均 < 0.05)。子宫内膜厚度 ≥ 8 mm组 IUI周期临床妊娠率及活产率均高于 < 8 mm组(P 均 < 0.05)。两组早期自然流产率比较差异无统计学意义($P > 0.05$)。倾向性评分匹配后比较,提示子宫内膜厚度显著影响IUI活产率($P < 0.05$)。单因素分析提示,女方年龄、男方年龄、女方BMI、基础促卵泡生成素(follicle stimulating hormone, FSH)、AMH、AFC、不孕年限、子宫内膜厚度、PR精子总数等因素均与IUI临床结局显著相关(P 均 < 0.05)。在调整上述单因素分析中有意义的混杂因素(除基础FSH外)后,采用多因素 Logistic 回归分析发现,子宫内膜厚度与临床妊娠(OR=1.933, 95% CI: 0.929~4.022, $P=0.078$)和活产(OR=1.838, 95% CI: 0.850~3.971, $P=0.122$)无显著相关性。结论:IUI周期子宫内膜厚度不影响临床妊娠结局,子宫内膜厚度作为单一超声指标在IUI人群中的预测价值有限,临床决策应综合考虑年龄、卵巢功能、精子因素和宫腔因素等综合因素,不能仅凭子宫内膜厚度决定是否取消或终止IUI,但面对子宫内膜厚度过低的IUI周期时临床决策仍需谨慎。

[关键词] 宫腔内夫精人工授精;子宫内膜厚度;临床妊娠率;活产率

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Analysis of the impact of endometrial thickness in intrauterine artificial insemination (IUI) cycles on pregnancy outcomes

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[Abstract] **Objective:** To explore the correlation between endometrial thickness in intrauterine insemination (IUI) cycles and clinical pregnancy outcomes. **Methods:** A retrospective analysis was conducted on 4 764 cycles of intrauterine sperm IUI in the Reproductive Medicine Center of Nanjing Drum Tower Hospital from 2016 to 2022. Based on the different endometrial thicknesses monitored by transvaginal ultrasound on the day of ovulation induction with human chorionic gonadotropin (hCG), the IUI cycles were divided into two groups: the endometrial thickness < 8 mm group ($n=395$) and the endometrial thickness ≥ 8 mm group ($n=4 369$). Differences in clinical pregnancy outcomes between the two groups were analyzed. Furthermore, a propensity score matching method was employed for a secondary analysis to control the influence of confounding variables, and univariate and multivariate Logistic

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regression analyses were applied to evaluate the effect of endometrial thickness on clinical pregnancy outcomes. **Results:** There were no statistically significant differences between the two groups in body mass index (BMI), basal follicle-stimulating hormone (FSH), duration of infertility, number of IUI cycles, IUI protocols, number of IUI, or total number of progressive motility (PR)sperm (all $P > 0.05$). However, there was a statistically significant difference in the type of infertility between the two groups ($P < 0.05$). Compared with the endometrial thickness < 8 mm group, the group with endometrial thickness ≥ 8 mm had a lower average age for both the female and male patients, and significantly higher levels of anti-Müllerian hormone (AMH) and antral follicle count (AFC) (all $P < 0.05$). The clinical pregnancy rate and live birth rate in the IUI cycles with endometrial thickness ≥ 8 mm were higher than those in the < 8 mm group ($P < 0.05$). There was no statistically significant difference in the early spontaneous abortion rate between the two groups ($P > 0.05$). After propensity score matching, endometrial thickness was found to have a significant effect on the live birth rate of IUI ($P < 0.05$). Univariate analysis indicated that factors such as female age, male age, female BMI, basal FSH, AMH, AFC, duration of infertility, endometrial thickness, and total number of PR sperm were significantly associated with the clinical outcomes of IUI (all $P < 0.05$). After adjusting for the significant confounding factors identified in the univariate analysis (except for basal FSH), multivariate logistic regression analysis revealed that endometrial thickness was not significantly associated with clinical pregnancy (OR=1.933, 95% CI: 0.929–4.022, $P=0.078$) or live birth (OR=1.838, 95% CI: 0.850–3.971, $P=0.122$). **Conclusion:** The endometrial thickness during the IUI cycle does not affect the clinical pregnancy outcome. The predictive value of endometrial thickness as a single ultrasound indicator in the IUI population is limited. Clinical decisions should comprehensively consider factors such as age, ovarian function, sperm factors, and uterine cavity factors. The decision on whether to cancel or terminate IUI should not be made solely based on endometrial thickness. However, when it comes to IUI cycles with too low endometrial thickness, clinical decisions still need to be made with caution.

[Key words] intrauterine insemination; endometrial thickness; clinical pregnancy rate; live birth rate

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不孕症已经成为当今社会不可忽视的一个社会问题。全球有8%~12%的生育年龄夫妇受到不孕症的困扰^[1]。不孕症对患者、家庭及社会造成的负面影响一直备受关注,已成为公共卫生领域的核心议题^[2-3]。辅助生殖技术(assisted reproductive technology, ART)已成为解决不孕不育问题的主要方案之一^[4]。宫腔内人工授精(intrauterine insemination, IUI)作为ART的重要组成部分,因操作简便、并发症发生率低、经济成本较低且更接近自然受孕^[5],在辅助生殖临床工作中被广泛应用,因此其妊娠成功率及影响因素也成为临床关注的焦点。在探讨临床妊娠结局时,子宫内膜厚度是一个常用的参考指标,目前关于子宫内膜厚度对妊娠结局影响的研究多集中于体外受精-胚胎移植(*in vitro* fertilization-embryo transfer, IVF-ET)周期,而针对IUI周期的相关研究相对较少,缺乏大样本数据,尚未形成统一结论^[6-7]。因此,探讨子宫内膜厚度对IUI妊娠结局的影响,对于优化IUI患者的个性化治疗方案具有重要的临床指导意义。本研究回顾性分析南京鼓楼医院生殖医学中心的相关数据,探讨子宫内膜厚度与IUI临床妊娠结局的相关性,以期为临床决策提供参考依据。

1 对象和方法

1.1 对象

回顾性分析2016—2022年在南京鼓楼医院生殖医学中心进行的4 764个IUI周期的临床资料。根据人绒毛膜促性腺激素(human chorionic gonadotropin, hCG)诱导排卵当日经阴道超声监测子宫内膜厚度,将患者分为2组:内膜厚度 < 8 mm组($n=395$ 例)和内膜厚度 ≥ 8 mm组($n=4 369$ 例)。入组标准:女方20~40岁;输卵管至少一侧通畅;妇科盆腔超声正常。排除标准:染色体异常;子宫或内膜病变;中重度子宫内膜异位症;数据缺失或治疗周期取消。本研究经南京大学医学院附属鼓楼医院医学伦理委员会批准(伦理号:2021-384-01)。

1.2 方法

所有入组患者在治疗前均已完成妇科超声、输卵管通畅性检查及精液分析等常规检查。根据患者月经周期及排卵等情况采用自然周期或促排卵周期。自然周期方案:月经规律有排卵患者于月经第10~12天开始超声动态监测卵泡和内膜生长情况,并同步检测外周血性激素水平。促排卵周期方案:月经不规律无排卵或卵泡发育异常患者于月经

第3~5天开始口服克罗米芬(50 mg, qd, 5 d)或者来曲唑(2.5 mg, qd, 5 d),然后根据卵泡内膜生长情况和激素水平调整人类绝经期促性腺激素(human menopausal gonadotropin, HMG)注射剂量(37.5~300.0 U)。两种方案均结合雌激素(estrogen, E₂)、黄体生成素(luteinizing hormone, LH)及主导卵泡直径决定注射hCG时机,人工授精于hCG注射后第1天进行,若未排卵,次日再行1次人工授精。男方在行人工授精手术日采集精液,采集前3~7 d内禁欲。随后进行精液优选处理。手术医生将处理好的精子悬液通过专用IUI导管轻柔注入子宫腔。IUI手术后的患者自排卵日开始口服地屈孕酮片10 mg bid。IUI术后16~18 d检测血β-hCG水平,阳性患者术后约35 d行阴道超声检查确定是否临床妊娠。

观察指标包括临床一般资料包括女方年龄、男方年龄、不孕类型、不孕年限、女方BMI、基础促卵泡生成素(follicle stimulating hormone, FSH)、抗缪勒氏激素(anti-Müllerian hormone, AMH)、窦卵泡计数(antral follicle count, AFC)、IUI周期数、IUI方案、子宫内膜厚度、前向运动精子总数等指标。主要观察指标为临床妊娠率、活产率。次级观察指标为早期流产率。临床妊娠率定义为:临床妊娠周期数/IUI周期数×100%。活产率定义为:活产周期数/IUI周期数×100%。早期流产率定义为:早期流产周期数/临床妊娠周期数×100%。

1.3 统计学方法

采用EmpowerStats 3.6.0软件进行数据分析。首先对数据进行正态性检验:符合正态分布的计量资料以均数±标准差($\bar{x} \pm s$)表示,组间比较采用独立样本 t 检验;不符合正态分布的计量资料以中位数(四分位数)[$M(P_{25}, P_{75})$]表示,组间比较采用Mann-Whitney U 检验。计数资料以频数(百分率)[$n(\%)$]表示,组间比较采用卡方检验。为减少混杂偏倚,采用倾向评分匹配(propensity score matching, PSM)法按1:1比例进行匹配,以标准化均数差(standardized mean difference, SMD)评估匹配后变量的均衡性,SMD < 0.1认为匹配效果良好。采用单因素及多因素Logistic回归分析筛选影响临床结局的因素。所有检验均为双侧检验, $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 患者临床资料相关情况的比较

本研究共纳入4 764个IUI周期,按子宫内膜厚度分为2组:< 8 mm组(395例),≥8 mm组(4 369例)。

两组患者BMI、基础FSH、不孕年限、IUI周期数、IUI周期方案、IUI次数、PR精子总数比较差异均无统计学意义(P 均>0.05)。≥8 mm组原发不孕占比高于< 8 mm组,患者较年轻,AMH、AFC较高($P < 0.05$,表1)。≥8 mm组临床妊娠率及活产率均高于< 8 mm组($P < 0.05$,表1)。两组早期自然流产率比较差异无统计学意义($P > 0.05$)。

2.2 PSM后患者临床资料比较

为减少混杂因素的影响,采用PSM法按1:1比例对两组患者进行匹配,最终成功匹配392对。两组患者年龄、BMI、基础FSH、AMH、AFC、不孕年限、IUI周期数、IUI周期方案、IUI次数、PR精子总数比较均差异无统计学意义($P > 0.05$)。≥8 mm组原发不孕占比高于< 8 mm组($P < 0.05$)。≥8 mm组活产率高于< 8 mm组($P < 0.05$,表2)。两组临床妊娠率、早期自然流产率比较差异无统计学意义($P > 0.05$)。

2.3 影响IUI周期临床妊娠和活产的单因素Logistic回归分析

如表3中结果显示,女方年龄、男方年龄、女方BMI、基础FSH、AMH、AFC、不孕年限、子宫内膜厚度、PR精子总数等因素均显著影响IUI的临床妊娠和活产,具有统计学意义($P < 0.05$)。

2.4 子宫内膜厚度与临床结局关系的多因素Logistic回归分析

为了控制混杂偏倚因素,本研究在调整女方年龄、男方年龄、BMI、AMH、AFC、不孕年限、PR精子总数和治疗方案这些因素后,采用Logistic回归分析子宫内膜厚度与临床结局的关联。结果显示,子宫内膜厚度与临床妊娠(OR=1.933, 95% CI: 0.929~4.022, $P=0.078$)和活产(OR=1.838, 95% CI: 0.850~3.971, $P=0.122$)无统计学显著相关性。

3 讨论

在ART中,与体外受精(*in vitro* fertilization, IVF)和卵胞浆内单精子注射(intracytoplasmic sperm injection, ICSI)相比,人工授精技术具有自身独特的优点。研究表明,IUI是不明原因不孕症夫妇的一线治疗方案^[8]。然而,与IVF/ICSI周期相比,IUI的妊娠成功率相对较低^[9],如何有效提高IUI周期的成功率成为临床关注的热点。相关研究表明,影响IUI周期成功率的因素众多,其中子宫内膜厚度作为评估子宫内腔容受性的重要指标,被认为是一个不可忽视的关键因素^[10]。目前关于子宫内膜厚度对IUI周期妊娠率的影响,尚未形成统一结论。

表1 2组临床资料相关情况比较

Table 1 Comparison of relevant clinical data of the two groups

Clinical data	<8 mm group(n=395)	≥8 mm group(n=4 369)	P
Female age(years, $\bar{x} \pm s$)	30.25 ± 3.87	29.36 ± 3.46	< 0.001
Male age(years, $\bar{x} \pm s$)	31.44 ± 4.41	30.72 ± 4.20	< 0.001
BMI(kg/m ² , $\bar{x} \pm s$)	22.85 ± 3.54	22.89 ± 3.54	0.859
Baseline FSH(U/L, $\bar{x} \pm s$)	7.21 ± 2.03	7.20 ± 1.95	0.861
AMH[ng/mL, M(P ₂₅ , P ₇₅)]	3.04(2.28, 5.43)	3.85(2.49, 6.26)	0.028
AFC($\bar{x} \pm s$)	17.64 ± 6.64	18.68 ± 7.13	0.011
Type of infertility[n(%)]			< 0.001
Primary infertilit	199(50.38)	3 138(71.82)	
Secondary infertility	196(49.62)	1 231(28.18)	
Duration of infertility[years, M(P ₂₅ , P ₇₅)]	3.00(2.00, 4.00)	3.00(2.00, 4.00)	0.160
IUI cycles[M(P ₂₅ , P ₇₅)]	1.00(1.00, 2.00)	1.00(1.00, 2.00)	0.372
IUI protocol[n(%)]			0.072
Natural cycle	36(9.11)	558(12.77)	
Microstimulation protocol	349(88.35)	3 732(85.42)	
Simple gn protocol	10(2.53)	79(1.81)	
Endometrial thickness(mm, $\bar{x} \pm s$)	7.22 ± 0.41	10.37 ± 1.82	< 0.001
Number of IUI[n(%)]			0.259
1	78(19.75)	764(17.49)	
2	317(80.25)	3 605(82.51)	
Progressive motility total sperm count[×10 ⁶ , M(P ₂₅ , P ₇₅)]	18.00(10.91, 24.20)	17.41(10.80, 26.64)	0.871
Clinical pregnancy rate[n(%)]	50(12.66)	830(19.00)	0.002
Early miscarriage rate[n(%)]	11(22.00)	129(15.54)	0.225
Live birth rate[n(%)]	38(9.62)	683(15.63)	0.001

表2 PSM后2组临床资料比较

Table 2 Comparison of clinical data between the two groups after PSM

Variable	< 8mm group(n=392)	≥ 8 mm group(n=392)	P
Female age(years, $\bar{x} \pm s$)	30.13 ± 3.70	30.31 ± 3.65	0.503
Male age(years, $\bar{x} \pm s$)	31.35 ± 4.29	31.74 ± 4.67	0.214
BMI(kg/m ² , $\bar{x} \pm s$)	22.84 ± 3.55	22.82 ± 3.44	0.939
Baseline FSH(U/L, $\bar{x} \pm s$)	7.16 ± 1.99	7.21 ± 1.82	0.736
AMH[ng/mL, M(P ₂₅ , P ₇₅)]	3.04(2.35, 5.54)	3.69(2.16, 5.50)	0.919
AFC($\bar{x} \pm s$)	17.77 ± 6.57	16.93 ± 6.55	0.075
Type of infertility[n(%)]			<0.001
Primary infertility	200(51.02)	269(68.62)	
Secondary infertility	192(48.98)	123(31.38)	
Duration of infertility[years, M(P ₂₅ , P ₇₅)]	3.00(2.00, 4.00)	3.00(2.00, 4.00)	0.061
IUI cycles[M(P ₂₅ , P ₇₅)]	1.00(1.00, 2.00)	1.00(1.00, 2.00)	0.443
IUI protocol[n(%)]			0.309
Natural cycle	34(8.67)	47(11.99)	
Microstimulation protocol	348(88.78)	336(85.71)	
Simple Gn protocol	10(2.55)	9(2.30)	
Endometrial thickness(mm, $\bar{x} \pm s$)	7.22 ± 0.40	10.34 ± 1.80	< 0.001
Number of IUI[n(%)]			0.265
1	77(19.64)	64(16.33)	
2	315(80.36)	328(83.67)	
Progressive motility total sperm count[×10 ⁶ , M(P ₂₅ , P ₇₅)]	18.00(11.06, 24.85)	18.65(11.77, 25.20)	0.816
Clinical pregnancy rate[n(%)]	50(12.76)	67(17.09)	0.109
Early miscarriage rate[n(%)]	11(22.00)	7(10.45)	0.087
Live birth rate[n(%)]	38(9.69)	58(14.80)	0.038

表3 影响IUI周期临床妊娠和活产的单因素 Logistic 回归分析

Table 3 Univariate logistic regression analysis of factors affecting clinical pregnancy and live birth in IUI cycles

Variable	Clinical pregnancy		Live birth	
	OR(95%CI)	P	OR(95%CI)	P
Female age	0.960(0.940-0.981)	< 0.001	0.943(0.921-0.965)	< 0.001
Male age	0.974(0.956-0.992)	0.004	0.965(0.946-0.985)	< 0.001
BMI	1.060(1.039-1.082)	< 0.001	1.053(1.031-1.076)	< 0.001
Baseline FSH	0.930(0.894-0.966)	< 0.001	0.921(0.883-0.961)	< 0.001
AMH	1.094(1.040-1.152)	< 0.001	1.086(1.029-1.145)	0.002
AFC	1.026(1.016-1.036)	< 0.001	1.027(1.016-1.038)	< 0.001
Type of infertility				
Primary infertility	1.000	-	1.000	-
Secondary infertility	1.078(0.920-1.263)	0.353	1.048(0.882-1.244)	0.594
Duration of infertility	0.942(0.906-0.980)	0.003	0.946(0.907-0.987)	0.011
IUI cycles	0.901(0.811-1.001)	0.052	0.919(0.820-1.030)	0.145
IUI protocol				
Natural cycle	1.000	-	1.000	-
Microstimulation protocol	1.324(1.043-1.680)	0.021	1.352(1.041-1.757)	0.024
Simple Gn protocol	1.540(0.884-2.682)	0.127	1.739(0.970-3.118)	0.063
Endometrial thickness				
<8 mm	1.000	-	1.000	-
≥8 mm	1.618(1.192-2.198)	0.002	1.741(1.234-2.456)	0.002
Number of IUI				
1	1.000	-	1.000	-
2	1.131(0.929-1.377)	0.22	1.089(0.881-1.346)	0.431
Progressive motility total sperm count	0.924(0.877-0.975)	0.004	0.918(0.866-0.973)	0.004

Huniadi 等^[11]研究发现,在 IUI 周期中,子宫内膜厚度增加时妊娠率升高。也有研究表明当子宫内膜厚度在 8~12 mm 时, IUI 周期临床妊娠率最高^[12]。而 Zheng 等^[13]研究表明子宫内膜厚度并不影响 IUI 周期的妊娠率。本研究回顾性分析了单中心 4 764 例行 IUI 治疗的临床样本数据,系统评估了子宫内膜厚度对于 IUI 周期临床妊娠率和活产率的预测价值。本研究最初的观察结果显示,在 2 组基线及临床结局资料的比较中,子宫内膜 < 8 mm 组临床妊娠率与活产率均显著低于 ≥ 8 mm 组,子宫内膜厚度与 IUI 周期临床妊娠率呈正相关,与多数既往研究的结论一致。而子宫内膜 < 8 mm 组的女性年龄更大(30.25 岁 vs. 29.36 岁, $P < 0.001$)、AFC 更低(17.64 个 vs. 18.68 个, $P=0.011$)、AMH 更低(4.11 ng/mL vs. 4.69 ng/mL, $P=0.028$)。这些因素对于 ART 成功率会产生负面影响,比如随着年龄增长,子宫内膜在分子和细胞水平发生退行性变化。这包括激素受体水平异常、蜕膜化过程受损,影响胚胎植入,以及胶原沉积增加,导致子宫内膜血流减少、容受性下降^[14]。在未

调整混杂因素的情况下,子宫内膜厚度 < 8 mm 似乎与 IUI 周期妊娠率及活产率下降相关。但在校正女方年龄、男方年龄、BMI、AMH、AFC、不孕年限、PR 精子总数及 IUI 周期方案等潜在混杂变量之后, Logistic 多因素回归分析结果表明子宫内膜厚度并非预测 IUI 周期临床妊娠率与活产率的独立因素。关于子宫内膜厚度与 ART 生殖结局之间关系的文献并不完全一致。有研究表明,在 IVF 技术中,子宫内膜厚度是影响胚胎着床的关键因素之一^[15]。最近的一项大样本国际多中心回顾性队列研究发现,所有中心子宫内膜薄的患者都表现出活产率下降,但下降的幅度和子宫内膜厚度的阈值因中心和周期类型而异^[16]。Gao 等^[17]进行的一项荟萃分析发现,较薄的子宫内膜厚度与较低的妊娠率、着床率和活产率或持续妊娠率相关。Huang 等^[18]研究表明,子宫内膜厚度在不同 ART 周期类型中与临床妊娠率和活产率具有非线性关联,没有单一的临界值。虽然较厚的子宫内膜厚度通常与改善的结果相关,但其对活产率的总体预测价值有限。因此,

这些结论在不同研究中受助孕周期类型、测量时间点、移植时机以及患者群体差异的影响较大。

近年来,评估子宫内膜容受性的方法取得了进步,从传统的成像技术转向了现代分子生物学方法。而分子标志物如胞饮突、整合素 $\alpha v\beta 3$ 及其配体骨桥蛋白(osteopontin, OPN)和同源盒基因A10在临床上被广泛用于评估子宫内膜容受性。内膜容受性受损是导致植入失败的核心因素^[19]。结合这些参数评估,可能比单纯厚度更具有预测价值。而子宫内膜厚度作为超声指标难以独立预测容受性,一个指标评估子宫内膜容受性相对片面,其与分子层面容受性机制之间的相互作用尚不明确。本研究结果提示子宫内膜厚度的影响在多因素模型中失去统计学意义,这提示子宫内膜厚度与IUI结局之间的表面关联很大程度上受到其他变量因素的混淆影响。同时,与IVF周期中内膜评价维度相比存在差异,IVF周期中,胚胎质量相对可控,内膜容受性成为妊娠成功的关键因素之一;而IUI周期依赖自然受精和输卵管内胚胎发育,精子质量、受精时机、输卵管功能等因素权重更高,内膜厚度的相对贡献可能被稀释。

虽然在未校正的情况下比较显示,子宫内膜厚度 ≥ 8 mm组的临床妊娠率和活产率高于子宫内膜厚度 < 8 mm组,但在调整年龄、卵巢储备和其他基线差异后,子宫内膜厚度并未成为IUI临床妊娠率或活产率的独立预测因子。子宫内膜厚度反映的是内膜纵向生长程度,并不能全面反映子宫内膜容受性。基于现有数据,不建议仅凭子宫内膜厚度 < 8 mm这个单一指标取消IUI周期或立即转入IVF周期。在临床工作中对于内膜不厚的患者应作全面评估,包括评估女方年龄、卵巢储备、男方精液等情况。

综上所述,本回顾性研究结果提示,子宫内膜厚度作为单一超声指标在IUI人群中的预测价值有限,临床决策应综合考虑年龄、卵巢功能、精子因素和宫腔因素等因素,不能仅凭厚度数值决定是否取消或终止IUI。但面对子宫内膜厚度过薄时临床决策仍需谨慎。此外,本研究仍有很多局限性,由于数据系统的限制,纳入的研究对象为IUI周期而非患者个体,极少部分患者的重复IUI周期可能会对相关性分析结果产生轻微影响。而本研究最大的局限性是回顾性的研究设计,存在选择性偏倚的可能。尽管本研究已调整多项基线变量,但仍可能存在未测量排卵后内膜厚度数据等指标或未纳入模型的混杂因子如子宫内膜炎症、既往宫腔操作史

等。目前尚缺乏将子宫内膜厚度与生物标志物联合分析的研究,未来的研究应结合超声指标与内膜分子水平,开展大样本前瞻性和随机研究,系统评估IUI周期妊娠结局的影响因素,为临床决策提供依据。

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所有作者均声明没有利益冲突。

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陆菲菲负责调查研究,资料搜集与分析,参与论文初稿撰写及后续修订工作;黄晨阳负责数据的清洗、存储与管理,完成统计分析,并协助论文审阅与修改;邢俊提出了整体研究思路与设计,制定了研究方法,提供研究资源,全程监督并指导研究进程,负责论文的审阅与修订,同时协调团队成员之间的沟通与协作。

Author's Contributions:

LU Feifei was responsible for investigation and research, data collection and analysis, and participated in the initial draft writing and subsequent revision of the paper. HUANG Chenyang was responsible for data cleaning, storage and management, conducted statistical analysis, and assisted in the review and revision of the paper. XING Jun proposed the overall research idea and design, formulated the research methods, provided research resources, supervised and guided the research process throughout, was responsible for the review and revision of the paper, and coordinated communication and collaboration among team members.

[参考文献]

- [1] VANDER BORGHT M, WYNS C. Fertility and infertility: definition and epidemiology[J]. Clin Biochem, 2018, 62: 2-10
- [2] SHARMA A, SHRIVASTAVA D. Psychological problems related to infertility[J]. Cureus, 2022, 14(10): e30320
- [3] SWIFT A, REIS P, SWANSON M. Infertility-related stress and quality of life in women experiencing concurrent reproductive trauma [J]. J Psychosom Obstet Gynaecol, 2022, 43(2): 171-176
- [4] TENCHOV R, ZHOU Q A. Assisted reproductive technology: a ray of hope for Infertility. ACS omega[J]. 2025, 10(22): 22347-22365
- [5] LEUSDER M, VAN ELTEN H J, AHAUS K, et al. Protocol for improving the costs and outcomes of assistive reproductive technology fertility care pathways: a study using cost measurement and process mining[J]. BMJ Open, 2023, 13(6): e067792
- [6] GUAN H, TANG H, PAN L, et al. Pregnancy predictors in unexplained infertility after intrauterine insemination[J].

- J Gynecol Obstet Hum Reprod, 2021, 50: 102071
- [7] RACHMAWATIA A, KRISNADI S R, SANTOSO S A, et al. Association between folliclesize, endometrialthickness, and types of ovarian stimulation (Clomiphene citrate and Letrozole)with biochemical pregnancy rate in women undergone intrauterine insemination[J]. BMC Res Notes, 2023, 16(1): 286
- [8] MAN J K, PARKER A E, BROUGHTON S, et al. Should IUI replace IVF as first-line treatment for unexplained infertility? A literature review [J]. BMC Women's Health, 2023, 23(1): 557
- [9] BAHADUR G, HOMBURG R, BOSMANS J E, et al. Observational retrospective study of UK national success, risks and costs for 319, 105 IVF/ICSI and 30, 669 IUI treatment cycles[J]. BMJ Open, 2020, 10: e034566
- [10] WANG X, ZHANG Y, SUN H L, et al. Factors affecting artificial insemination pregnancy outcome [J]. Int J Gen Med, 2021, 14: 3961-3969
- [11] HUNIADI A, BIMBO -SZUHAI E, BOTEVA M. Fertility predictors in intrauterine insemination (IUI) [J]. J Pers Med, 2023, 13(3): 395
- [12] ZHANG K, SHI Y, WANG E, et al. Ovarian stimulated cycle: not a better alternative for women without ovulation disorder in intrauterine insemination [J]. Oncotarget, 2017, 8: 100773100780
- [13] ZHENG J, CAI J, LIU L, et al. Low BMI is associated with poor IUI outcomes: a retrospective study in 13, 745 cycles [J]. J Assist Reprod Genet, 2022, 39 (12) : 2819-2825
- [14] PATHARE A D S, LOID M, SAARE M, et al. Endometrial receptivity in women of advanced age: an underrated factor in infertility [J]. Hum Reprod Update, 2023, 29 (6): 773-793
- [15] PÉREZ-MILÁN F, CABALLERO-CAMPO M, CARRERA-ROIG M, et al. Impact of endometrial thickness on reproductive outcome in fresh and frozen-thawed embryo transfer: systematic review and meta-analysis [J]. Ultrasound Obstet Gynecol, 2025, 66(3): 271-281
- [16] GENOVESE H, MAYO C A, KALAFAT E, et al. Does endometrial thickness impact live birth rate following a frozen embryo transfer: outcomes of 30 676 euploid single embryo transfers[J]. Hum Reprod, 2025, 40(10): 1919-1927
- [17] GAO G, CUI X, LI S, et al. Endometrial thickness and IVF cycle outcomes: a meta-analysis[J]. Reprod Biomed Online, 2020, 40(1): 124-133
- [18] HUANG W, TANG J, WEI L, et al. Association of endometrial thickness with live birth rates among women undergoing fresh IVF, FET, and PGT cycles [J]. Front Cell Dev Biol, 2025, 13: 1530953
- [19] LI J, LIU H, LIM J, et al. Molecular and biological markers for assessing endometrial receptivity in infertile women: a narrative review [J]. J Int Med Res, 2025, 53 (4) : 3000605251328893
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