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# 新型冠状病毒肺炎疫情防控常态化 下人类辅助生殖机构和精子库应对 管理专家共识

国家辅助生殖技术质量管理专家组

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**【摘要】** 新型冠状病毒肺炎 (coronavirus disease 2019, COVID-19) 疫情的暴发和蔓延给人类生殖健康带来了极大的挑战。随着 COVID-19 疫情的日趋稳定, 在疫情防控常态化下安全稳妥地为不孕不育患者提供辅助生殖技术服务成为重要工作。国家辅助生殖技术质量管理专家组依据国家卫生健康主管部门对 COVID-19 感染防控要求, 结合辅助生殖技术的特点, 从门诊就诊、住院治疗、手术室、治疗随访、辅助生殖实验室和精子库等方面总结经验和建议形成本共识, 以期为全国辅助生殖机构顺利复工复产提供参考和借鉴。

**【关键词】** 新型冠状病毒肺炎; 生殖技术, 辅助; 精子库; 专家共识

**Expert consensus on the regular prevention and control measurements of COVID-19 in assisted reproductive technology institutions and human sperm banks**

National Expert Group for Quality Management on Assisted Reproductive Technology

Corresponding author: Qiao Jie, Email: jie.qiao@263.net, Tel: +86-10-82265252

**【Abstract】** COVID-19 pandemic has proved to be a great challenge to human reproductive health. Although the COVID-19 epidemic has been controlled in China, the strict prevention and control measurements are still warranted and should be normalized at present period. Safely serving the infertile patient emerges to be an important work in this social background. According to the requirements

of the public health authorities and the characteristics of assisted reproductive technology (ART), experts from National Committee of Quality Management of ART have developed a consensus on outpatient clinic, hospitalization, operation room, ART laboratory and human sperm bank, in order to provide recommendations on the resumption of services in ART institutions in China.

**【Key words】** COVID-19; Reproductive technology, assisted; Sperm bank; Expert consensus

## · 新型冠状病毒专栏 ·

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# 新型冠状病毒肺炎疫情对辅助生殖 技术服务的影响: 一项全国性横断 面调查

国家辅助生殖技术质量管理专家组

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**【摘要】** 目的 了解新型冠状病毒肺炎疫情对全国不孕不育症诊疗技术——辅助生殖技术服务的影响情况, 为生殖医学中心和精子库的复工复产工作提供指导性意见, 以便更好地保障育龄夫妇获得生殖健康相关医疗服务。方法 2020年5月, 采用线上问卷调查的方式向中国内地31个省(自治区、直辖市)已批准开展人类辅助生殖技术的517家生殖医学中心和27家人类精子库的机构负责人进行调查。主要调查内容包括: 2019年及2020年1~4月各机构的辅助生殖技术服务量、开展的疫情防控措施、医患感染情况、疫情期间业务暂停及复工复产情况等。结果 本次调查共获得475家生殖医学中心和22家精子库的有效反馈, 分别占全国总机构数的91.9%和81.5%。在新型冠状病毒肺炎疫情期期间, 63.6% (302/475) 的生殖医学中心和95.5% (21/22) 的精子库都受疫情影响而暂停对外业务。与2019年同期相比, 2020年1~4月份生殖医学中心的门诊量、夫精人工授精周期数、供精人工授精周期数、取卵周期数、新鲜移植周期数和解冻移植周期数的下降比例分别为

45.0%、46.5%、52.8%、49.2%、52.3%和 37.1% ( 疫情最严重的湖北省下降比例在 70%~90% ) ,精子库的捐精人数和自精保存人数下降比例分别为 60.7%和 51.1%。全国生殖医学中心共上报了 5 例工作人员新型冠状病毒感染病例 ( 均在湖北省 ) ,精子库未出现工作人员感染病例。结论 针对目前新型冠状病毒肺炎疫情防控常态化的形势 ,应制定专门针对生殖医学中心和精子库的疫情防控流程和新型冠状病毒筛查指南 ,有必要建立一个患者分层分级动态评估及管理体系 ,从而帮助机构在疫情防控期间迅速鉴别出来哪些患者需要向其优先提供生育治疗服务。

【关键词】 生殖技术 , 辅助 ; 新型冠状病毒肺炎 ; 卫生质量管理

## **Impacts of COVID-19 pandemics on the services of assisted reproductive technology in Chinese mainland: a national cross-sectional survey**

*National Expert Group for Quality Management on Assisted Reproductive Technology*

*Corresponding author: Qiao Jie, Email: jie.qiao@263.net, Tel: +86-10-86626868*

**【Abstract】 Objective** To explore the impacts of COVID-19 pandemics on assisted reproductive technology (ART) services in Chinese mainland, and then to provide evidence-based guidance for the following resumption of ART centers and sperm banks. **Methods** In May 2020, an online questionnaire survey was conducted in all 517 ART centers and 27 sperm banks from all 31 provinces in Chinese mainland. The services number of different technologies in 2019 and 2020 (from January to April), the epidemic prevention and control measures have being taken, infectious numbers of medical workers and patients seeking for ART services, and situations about the business suspension and resumption during the epidemic period in these institutions were surveyed. **Results** Among all surveyed institutions, there were 475 ART centers (91.9%) and 22 sperm banks (81.5%) that completed the online questionnaire. Totally, 63.6% (302/475) of ART centers and 95.5% (21/22) of sperm banks suspended services due to the outbreak of COVID-19. The comparison between the period from January to April in 2020 and that in 2019 showed that the total number of outpatients, artificial insemination with husband semen (AIH) cycles, artificial insemination with donor semen (AID) cycles, aspiration cycles, fresh embryo transfer cycles, and frozen embryo transfer (FET) cycles decreased by 45.0%, 46.5%, 52.8%, 49.2%, 52.3% and 37.1% (70%~90% in Hubei Province as the hardest-hit area), and that the total number of sperm donors and those seeking self-sperm preservation decreased by 60.7% and 51.1%. A total of 5 medical staff infected with COVID-19 were reported by ART centers and all cases were in Hubei Province; none of infected cases among medical staff was reported by sperm banks. **Conclusion** During the "new normal" period of COVID-19, it is urgent to develop specific COVID-19 prevention and control procedures and screening guidelines for ART centers and sperm banks. It is necessary to establish a dynamic hierarchical evaluation and management system for ART patients, in order to efficiently identify those patients who need fertility treatment services with priority.

**【Key words】** Reproductive technology, assisted; COVID-19; Health quality management

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# 新型冠状病毒肺炎疫情对北京市辅助生殖技术服务的影响及对后疫情时代的提示

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**【摘要】** 目的 了解新型冠状病毒肺炎 (coronavirus disease 2019, COVID-19) 疫情对北京市辅助生殖技术服务的影响; 探讨后疫情时代辅助生殖技术服务的质控重点, 以及对临床治疗的提示。方法 采用发放调查表的方式, 对北京市属 12 个人类辅助生殖技术执业点, 分别在 2019 和 2020 年 1 月 1 日至 4 月 30 日的辅助生殖技术开展情况进行调研。结果 2020 年 1~4 月, 北京市属 12 家开展人类辅助生殖技术服务的机构总门诊量较去年同期下降 54.4%。2020 年 1~4 月, 夫精人工授精、供精人工授精、体外受精-新鲜胚胎移植和解冻胚胎移植的临床妊娠率分别为 11.7%、20.5%、38.4% 和 45.9%, 与 2019 年 1~4 月 (11.6%、23.1%、40.3%、46.0%) 相比差异均无统计学意义 ( $P=0.971$ 、 $P=0.469$ 、 $P=0.195$  和  $P=0.881$ )。结论 COVID-19 疫情影响下, 北京市的辅助生殖技术服务量明显下降, 但服务质量保持稳定。疫情常态化防控期间, 建议临床和胚胎实验室应进行分层质控分析; 为控制感染风险, 应准确把握各种治疗方案的适应证, 为患者制定最佳的助孕治疗方案。

**【关键词】** 生殖技术, 辅助; 新型冠状病毒肺炎; 质量控制

Impacts and prompts of COVID-19 outbreaking on assisted reproductive technology services in Beijing

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**【Abstract】 Objective** To explore the impacts of COVID-19 outbreaking on assisted reproductive technology (ART) services in Beijing, besides the tips of quality control points and treatment plans for future. **Methods** A questionnaire survey was conducted to investigate the situation of ART in 12 organizations in Beijing during January 1 to April 30, 2019 and 2020. **Results** From January to April of 2020, the total outpatient volume of 12 ART centers in Beijing decreased by 54.4%, compared with the same period of 2019. The clinical pregnancy rates were 11.7%, 20.5%, 38.4% and 45.9% for artificial insemination by husband, artificial insemination by donor semen, fresh embryo transfer and thawed embryo transfer, respectively, which showed no statistical difference from January to April 2019 (11.6%, 23.1%, 40.3%, 46.0%) ( $P=0.971$ ,  $P=0.469$ ,  $P=0.195$  and  $P=0.881$ ). **Conclusion** Under the influence of COVID-19, ART services were decreased in Beijing, while the quality remained stable. The quality control could be organized hierarchically for different situations, and extending to choose more efficient treatment programs to control the risk of infection for patients during the "new normal" period of COVID-19.

**【Key words】** Reproductive technology, assisted; COVID-19; Quality control

· 临床研究 ·

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# 两种长效促性腺激素释放激素激动 剂在早卵泡期超长方案中助孕结局 比较

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**【摘要】 目的** 比较两种长效促性腺激素释放激素激动剂 (gonadotropin-releasing hormone agonist, GnRH-a) 在早卵泡期超长方案中对体外受精/卵胞质内单精子注射 (*in vitro* fertilization/intracytoplasmic sperm injection, IVF/ICSI) 的助孕结局。**方法** 回顾性队列研究分析 2019 年 3 月 1 日至 2019 年 7 月 31 日期间在温州医科大学附属第二医院生殖医学中心采用两种不同 GnRH-a 在早卵泡期超长方案的患者共 802 例,根据长效 GnRH-a 的不同分为醋酸亮丙瑞林组 (A 组) 和曲普瑞林组 (B 组), 比较两组患者的临床和实验室结局。**结果** 两组患者年龄、不孕年限、体质量指数 (body mass index, BMI)、基础性激素水平、不孕类型、促性腺激素 (gonadotropin, Gn) 启动日性激素水平、Gn 使用时间、降调节时间、人绒毛膜促性腺激素 (human chorionic gonadotropin, hCG) 注射日雌二醇水平及子宫内膜厚度、移植胚胎数、临床结局、治疗总费用, 以及因内膜厚度不均、孕酮升高、胚胎质量问题、个体因素而取消移植率等比较, 差异均无统计学意义 ( $P>0.05$ )。但 B 组窦卵泡计数 (antral follicle count, AFC) ( $19.59\pm7.93$ )、获卵数 [ $(15.39\pm7.59)$  枚]、受精数 [ $(11.20\pm6.53)$  枚]、卵裂数 [ $(10.85\pm6.42)$  枚]、第 3 日优质胚胎数 [ $(3.01\pm2.66)$  枚]、囊胚数 ( $5.27\pm4.02$ ) 枚] 大于 A 组  $17.68\pm7.23$ 、( $13.70\pm6.94$ ) 枚、( $9.50\pm5.43$ ) 枚、( $9.26\pm5.34$ ) 枚、( $2.57\pm2.33$ ) 枚、( $4.49\pm3.40$ ) 枚] ( $P=0.001$ ,  $P=0.002$ ,  $P<0.001$ ,  $P=0.001$ ,  $P=0.017$ ,  $P=0.007$ )。A 组 hCG 注射日黄体生成素 (luteinizing hormone, LH) [ $(0.78\pm0.64)$  IU/L]、孕酮水平 [ $(0.72\pm0.39)$   $\mu\text{g/L}$ ] 高于 B 组 [ $(0.55\pm0.30)$  IU/L、( $0.64\pm0.36$ )  $\mu\text{g/L}$ ] ( $P<0.001$ ,  $P=0.005$ )。A 组为防止卵巢过度刺激综合征 (ovarian hyperstimulation syndrome, OHSS) 的发生取消移植率 [28.52% (75/263)] 高于 B 组 [14.95% (16/107)],  $P=0.006$ 。**结论** 两种长效 GnRH-a 药物应用于早卵泡期超长方案均可获得满意的降调节效果、实验室及临床结局, 但醋酸亮丙瑞林对垂体抑制相对温和, 相比较于曲普瑞林获得的临床妊娠率有升高趋势。

**【关键词】** 促性腺激素释放激素激动剂; 早卵泡期超长方案; 受精, 体外; 卵胞质内单精子注射; 选择性单囊胚移植

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# Comparison of the assisted-reproduction outcomes of two long-acting gonadotropin-releasing hormone agonists in the long-term early follicular phase

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**【Abstract】 Objective** To compare the assisted-reproduction outcomes of two long-acting gonadotropin-releasing hormone agonists (GnRH-a) in patients undergoing *in vitro* fertilization/intracytoplasmic sperm injection (IVF/ICSI) during the long-term early follicular phase. **Methods** A retrospective cohort study was conducted in the Reproductive Center of the Second Affiliated Hospital of Wenzhou Medical University from March 1, 2019 to July 31, 2019. A total of 802 patients were divided into leuporelin acetate group (group A) and triptorelin group (group B) according to the difference of long-acting GnRH-a in the long-term early follicular phase, and the clinical and laboratory outcomes between the two groups were compared. **Results** There were no significant differences in age, infertility duration, body mass index (BMI), basic hormone levels, infertility type, sex hormone level on the day of initiation of injection of gonadotropin (Gn), total duration and dosage of Gn used, duration of down-regulation, estradiol level and endometrial thickness on hCG injection day, the number of embryos transferred, clinical outcomes, total treatment cost, and owing to the uneven inner membrane, elevated progesterone, embryo quality problems, individual factors resulting in cancelling the transplant, between the two groups ( $P>0.05$ ). However, antral follicle count (AFC) ( $19.59\pm7.93$ ), the number of retrieved oocytes ( $15.39\pm7.59$ ), fertilized oocytes ( $11.20\pm6.53$ ), cleaved oocytes ( $10.85\pm6.42$ ), good-quality embryos on Day 3 ( $3.01\pm2.66$ ), and blastocysts ( $5.27\pm4.02$ ) in group B was larger than that in group A ( $17.68\pm7.23$ ,  $13.70\pm6.94$ ,  $9.50\pm5.43$ ,  $9.26\pm5.34$ ,  $2.57\pm2.33$ ,  $4.49\pm3.40$ ) ( $P=0.001$ ,  $P=0.002$ ,  $P<0.001$ ,  $P=0.001$ ,  $P=0.017$ ,  $P=0.007$ ). The levels of luteinizing hormone (LH) [ $(0.78\pm0.64)$  IU/L] and progesterone [ $(0.72\pm0.39)$   $\mu\text{g/L}$ ] on hCG injection day in group A were higher than those in group B [ $(0.55\pm0.30)$  IU/L,  $(0.64\pm0.36)$   $\mu\text{g/L}$ ] ( $P<0.001$ ,  $P=0.005$ ). The rate of preventing the occurrence of ovarian hyperstimulation syndrome (OHSS) in group A [28.52% (75/263)] was higher than that in group B [14.95% (16/107),  $P=0.006$ ]. **Conclusion** Two long-acting GnRH-a drugs can achieve satisfactory down-regulation effect, laboratory and clinical outcomes in the long-term early follicular phase. Compared with the triptorelin, leuprolide acetate is relatively mild to pituitary inhibition, with an increasing trend of the clinical pregnancy rate.

**【Key words】** Gonadotropin-releasing hormone agonist; The long-term early follicular phase; Fertilization *in vitro*; Intracytoplasmic sperm injection; Elective single embryo transfer

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# 高孕激素状态下促排卵治疗的卵泡 晚期应用低剂量人绒毛膜促性腺激 素对多囊卵巢综合征患者体外受精 结局的影响

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**【摘要】** 目的 探讨在高孕激素状态下促排卵治疗 (progestin-primed ovarian stimulation, PPOS) 的卵泡晚期应用低剂量的人绒毛膜促性腺激素 (human chorionic gonadotropin, hCG) 替代人绝经期促性腺激素 (human menopausal gonadotropin, hMG) 对多囊卵巢综合征 (polycystic ovary syndrome, PCOS) 患者体外受精 (*in vitro* fertilization, IVF) / 卵胞质内单精子注射 (intracytoplasmic sperm injection, ICSI) 结局的影响。方法 回顾性队列研究分析 2015 年 3 月至 2017 年 12 月期间在上海交通大学医学院附属第九人民医院辅助生殖科行 IVF/ICSI 治疗的 PCOS 患者的临床资料。促排卵方案均采用 PPOS，根据 PPOS 的卵泡晚期是否应用低剂量的 hCG 替代 hMG 分组：A 组，PPOS 常规方案组 (hMG+孕酮)，完全应用 hMG (141 个周期)；B 组，PPOS 卵泡晚期 hCG 替代 hMG 组 (hMG/hCG+孕酮)，即在 PPOS 促排卵治疗的卵泡晚期应用低剂量的 hCG (200 IU/d) 完全替代 hMG (80 个周期)。比较两组患者的临床资料和妊娠相关指标。本研究的主要监测指标包括获卵数、可用胚胎数和临床妊娠率。结果 两组的促排卵治疗时间 [A 组 ( $9.7 \pm 2.6$ ) d 比 B 组 ( $10.3 \pm 3.4$ ) d] 差异无统计学意义 ( $P=0.16$ )；B 组 hMG 用药时间 [( $7.8 \pm 3.5$ ) d] 及 hMG 用药量 [( $1592.8 \pm 840.5$ ) IU] 均显著低于 A 组 [( $9.7 \pm 2.6$ ) d,  $P=0.01$ ；( $1825.2 \pm 795.3$ ) IU,  $P=0.04$ ]；两组的获卵数和可用胚胎数差异均无统计学意义 ( $P>0.05$ )。在随后的冻融胚胎移植 (frozen-thawed embryo transfer, FET) 周期中，A 组与 B 组间患者的临床妊娠率 [52.8% (105/199) 比 49.2% (60/122)]、胚胎种植率 [37.1% (139/375)]

比 37.1% ( 86/232 ) ]、早期流产率 [ 4.8% ( 5/105 ) 比 5.0% ( 3/60 ) ] 及持续妊娠率 [ 47.7% ( 95/199 ) 比 44.3% ( 54/122 ) ] 差异均无统计学意义 (  $P>0.05$  )。

结论 PCOS 患者在 PPOS 的卵泡晚期应用低剂量的 hCG 替代 hMG, 能安全、有效地维持卵泡生长发育, 且不影响 PCOS 患者的 IVF/ICSI-FET 治疗的结局。

【关键词】 高孕激素状态下促排卵; 人绒毛膜促性腺激素; 人绝经期促性腺激素; 多囊卵巢综合征

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# Effect of low dosage of human chorionic gonadotropin in late follicular stage during progestin-primed ovarian stimulation on the outcome of *in vitro* fertilization for polycystic ovary syndrome patients

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【Abstract】 **Objective** To investigate the effect of low dosage of human chorionic gonadotropin (hCG) replacing human menopausal gonadotropin (hMG) in the late follicular stage during progestin-primed ovarian stimulation (PPOS) on the outcome of *in vitro* fertilization (IVF)/intracytoplasmic sperm injection (ICSI) for polycystic ovary syndrome (PCOS) patients. **Methods** The patients with PCOS who underwent IVF/ICSI-frozen-thawed embryo transfer (FET) treatment in the Department of Assisted Reproduction of Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine from March 2015 to December 2017 were retrospectively analyzed. Ovarian stimulation adopted PPOS. According to whether low dosage of hCG was used to replace hMG in the late follicular stage of PPOS, they were divided into two groups: group A, PPOS routine group (hMG + progesterone), complete application of hMG (141 cycles); group B, hMG/hCG+progesterone, low dosage of hCG (200 IU/d) was used to completely replace hMG in the late follicular stage of PPOS (80 cycles). The clinical data and pregnancy related indexes of the two groups were compared. The main outcome measures included the number of oocytes retrieved, the number of available embryos and clinical pregnancy rate. **Results** There was no significant difference in the duration of ovarian stimulation between group A and group B [(9.7±2.6) d vs. (10.3±3.4) d,  $P=0.16$ ]. The duration of hMG administration [(7.8±3.5) d] and the dosage of hMG [(1 592.8±840.5) IU] in group B were significantly lower than those in group A [(9.7±2.6) d,  $P=0.01$ ; (1 825.2±795.3) IU,  $P=0.04$ ]. There were no significant differences in the number of oocytes retrieved (17.3±8.9 vs. 17.8±8.8) and the number of available embryos (6.2±4.1 vs. 6.0±3.2) between the two groups ( $P>0.05$ ). In the subsequent FET cycle, the clinical pregnancy rate [52.8% (105/199) vs. 49.2% (60/122)], the embryo implantation rate [37.1% (139/375) vs. 37.1% (86/232)], the early abortion rate [4.8% (5/105) vs. 5.0% (3/60)] and the ongoing pregnancy rate [47.7% (95/199) vs. 44.3% (54/122)] were not statistically different between group A and group B. **Conclusion** The use of low dosage of hCG

instead of hMG in the late follicular stage of PPOS in patients with PCOS, which can safely and effectively maintain follicular growth and development, without affecting the outcome of IVF/ICSI-FET for PCOS patients.

**【Key words】** Progestin-primed ovarian stimulation; Human chorionic gonadotropin; Human menopausal gonadotropin; Polycystic ovary syndrome

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# 不同获卵数对体外受精-胚胎移植 每取卵周期累积活产率的影响: 一 项队列研究

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**【摘要】** 目的 分析体外受精-胚胎移植(*in vitro* fertilization-embryo transfer, IVF-ET)过程中不同获卵数对每取卵周期累积活产率的影响, 探讨IVF-ET的理想获卵数范围。方法 回顾性分析2016年3月至2018年12月期间在河南省人民医院生殖中心行控制性促排卵的10 002个周期。比较获卵数1~3枚、4~6枚、7~9枚、10~15枚、16~20枚、≥21枚患者的一般情况、临床实验室指标及临床结局, 通过多因素logistic回归分析调整混杂因素后获卵数对临床结局的影响, 通过曲线拟合及阈值效应分析获卵数对每取卵周期累积活产率的影响。结果 共收集到10 002个取卵周期, 获得活产共5904个周期, 总累积活产率59.03%(5904/10 002); 人绒毛膜促性腺激素(human chorionic gonadotropin, hCG)

注射日内膜厚度为 (10.31±3.09) mm, 获卵总数为 8.00 (5.00, 12.00) 枚, 成熟卵子数为 7.00 (4.00, 11.00) 枚, 正常受精数为 5.00 (2.00, 8.00) 枚, 第 3 日可利用胚胎数为 4.00 (2.00, 7.00) 枚。多因素 logistics 回归分析调整混杂因素后结果显示, 获卵数 1~3 枚患者 (OR=0.11, 95% CI=0.12~0.18)、获卵数 4~6 枚患者 (OR=0.32, 95% CI=0.33~0.44)、获卵数 7~9 枚患者 (OR=0.62, 95% CI=0.54~0.71) 每取卵周期累积活产率明显低于获卵数 10~15 枚患者 ( $P<0.0001$ ); 获卵数 16~20 枚患者 (OR=1.54, 95% CI=1.24~1.93)、获卵数  $\geq 21$  枚患者 (OR=2.49, 95% CI=1.76~3.52) 每取卵周期累积活产率明显高于获卵数 10~15 枚患者 ( $P<0.0001$ )。曲线拟合及阈值效应分析结果显示: 当获卵数  $<19$  枚时, 累积活产率随获卵数的增加明显增加, 获卵数每增加 1 枚, 累积活产率增加 16% (OR=1.16, 95% CI=1.15~1.18,  $P<0.0001$ ), 当获卵数  $\geq 19$  枚时, 累积活产率趋于平稳, 不再增加 (OR=1.00, 95% CI=0.96~1.05,  $P=0.8403$ )。结论 IVF-ET 周期中获卵数与每取卵周期累积活产率呈曲线关系, 当获卵数  $<19$  枚时, 累积活产率随获卵数的增加明显增加, 当获卵数达到 19 枚时, 累积活产率趋于平稳, 不再增加。

【关键词】 受精, 体外; 胚胎移植; 累积活产率; 获卵数

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# Effect of the number of oocytes obtained on the cumulative live birth rate per oocytes retrieval cycle in *in vitro* fertilization-embryo transfer: a cohort study

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【Abstract】 **Objective** To analyze the effect of age and number of oocytes obtained on the cumulative live birth rate per oocytes retrieval cycle in *in vitro* fertilization-embryo transfer (IVF-ET), and to explore the ideal number of oocytes obtained in IVF-ET. **Methods** Totally 10 002 controlled ovarian stimulation cycles from March 2016 to December 2018 in the Reproductive Medicine Center of Henan Provincial People's Hospital were studied retrospectively. The general condition, clinical and laboratory indicators and clinical outcomes of the different oocytes obtained numbers were compared, and multivariate logistic regression analysis after adjusting confounding factors was used to investigate the effect of the number of oocytes obtained on the clinical outcomes, curve fitting and threshold effect analysis were performed to analyze the influence of the number of oocytes obtained on the cumulative live birth rate per oocytes retrieval cycle. **Results** A total of 10 002 oocytes retrieval cycles were collected and a total of 5904 cycles of live births were obtained, with a total cumulative live birth rate of 59.03% (5904/10 002). The endometrial thickness on human chorionic gonadotropin (hCG) injection day was (10.31±3.09) mm, the median number of oocytes obtained was 8.00(5.00, 12.00), the median number of mature oocytes was 7.00(4.00, 11.00), and the median number of normal fertilization was 5.00(2.00, 8.00), the median number of embryos available on day 3 (D3) was 4.00(2.00, 7.00). The results of logistics regression analysis adjusted for

confounding factors showed that the cumulative live birth rate per egg retrieval cycle in patients with 1–3 oocytes obtained ( $OR=0.11$ , 95%  $CI=0.12-0.18$ ), 4–6 oocytes obtained ( $OR=0.32$ , 95%  $CI=0.33-0.44$ ), 7–9 oocytes obtained ( $OR=0.62$ , 95%  $CI=0.54-0.71$ ) was significantly lower than that of patients with 10–15 oocytes obtained ( $P<0.000\ 1$ ), while it was significantly higher in patients with 16–20 oocytes ( $OR=1.54$ , 95%  $CI=1.24-1.93$ ) and  $\geq 21$  oocytes ( $OR=2.49$ , 95%  $CI=1.76-3.52$ ) than that in patients with 10–15 oocytes obtained ( $P<0.000\ 1$ ). The curve fitting and threshold effect analysis results showed that when the number of oocytes obtained was less than 19, the cumulative live birth rate increased significantly with the number of oocytes obtained, 16% increase in cumulative live birth rate for each additional oocytes ( $OR=1.16$ , 95%  $CI=1.15-1.18$ ,  $P<0.000\ 1$ ). When the number of oocytes was  $\geq 19$ , the cumulative live birth rate was stable and no longer increased ( $OR=1.00$ , 95%  $CI=0.96-1.05$ ,  $P=0.840\ 3$ ). **Conclusion** There is a curve relationship between the number of oocytes obtained and the cumulative live birth in IVF-ET cycle. When the number of oocytes obtained was  $<19$ , the cumulative live birth rate increased significantly with the increase of the number of oocytes obtained, but when the number of oocytes obtained was  $\geq 19$ , the cumulative live birth rate did not increase significantly with it, but rather tend to be stable.

**【Key words】** Fertilization *in vitro*; Embryo transfer; Cumulative live birth rate; Number of oocytes retrieved

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# 子宫内膜厚度对冻融胚胎移植胎儿 出生体质量的影响

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【摘要】 目的 探讨冻融胚胎移植日子宫内膜厚度与胎儿出生体质量的关系。方法 选取2016年6月至2018年12月期间于郑州大学第三附属医院生殖医学中心行冻融胚胎移植的1622个单胎活产周期进行回顾性队列分析，根据移植日子宫内膜厚度分为4组，A组：子宫内膜厚度 $\leq 8$  mm；B组：子宫内膜厚度8~10 mm；C组：子宫内膜厚度10~12 mm；D组：子宫内膜厚度 $\geq 12$  mm。比较各组患者的一般资料及临床数据，以A组为参照组，控制混杂因素，计算其他各组低出生体质量（low birth weight，LBW）、极低出生体质量（very low birth weight，VLBW）、足月LBW、小于胎龄儿（small for gestational age，SGA）、早产的优势比（odds ratio，OR）及95%置信区间（95% CI），并采用多元线性回归分析影响胎儿出生体质量的相关因素。结果 4组胎儿的出生体质量依次为（3 350.15 $\pm$ 568.17）g、（3 431.84 $\pm$ 523.43）g、（3 445.93 $\pm$ 483.73）g、（3 482.27 $\pm$ 495.30）g，组间比较差异均无统计学意义（ $P>0.05$ ）。经多因素逻辑回归分析校正混杂因素后，A组的早产风险大于C组（OR=0.527，95% CI=0.287~0.968， $P=0.039$ ），移植日子宫内膜厚度不影响LBW、VLBW、足月LBW、SGA发生率（ $P$ 均 $>0.05$ ）。多元线性回归分析显示体质量指数（body mass index，BMI）、移植胚胎阶段、分娩孕周、新生儿性别均会影响胎儿出生体质量（ $P<0.001$ ， $P=0.003$ ， $P<0.001$ ， $P<0.001$ ）。结论 在冻融胚胎移植周期中，移植日子宫内膜厚度 $\leq 8$  mm的妇女发生早产的可能性比内膜厚度10~12 mm的妇女高，但子宫内膜厚度不影响胎儿出生体质量。

【关键词】 子宫内膜厚度； 冻融胚胎移植； 出生体质量

## Effect of endometrial thickness on birth weight in frozen-thawed embryo transfer cycles

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【Abstract】 **Objective** To investigate the effect of endometrial thickness on birth weight in frozen-thawed embryo transfer cycles. **Methods** A retrospective cohort analysis of 1622 single-birth live birth cycles of frozen-thawed embryo transfer at the Reproductive Center of the Third Affiliated Hospital of Zhengzhou University from June 2016 to December 2018 was performed. According to the endometrial thickness on the day of transplantation, the patients were divided into four groups, group A: endometrial thickness  $\leq 8$  mm; group B: endometrial thickness 8–10 mm; group C: endometrial thickness 10–12 mm; group D: endometrial thickness  $\geq 12$  mm. The general and clinical data of patients in each group were compared. Group A was used as the reference group to control confounding factors and the low birth weight (LBW) and very low birth weight (VLBW), term LBW, small for gestational age (SGA), preterm birth odds ratio (OR), and 95% confidence interval (95% CI) were calculated, and multiple linear

regression was used to analyze the impact factors related to the birth weight of the fetus. **Results** The fetal birth weights of the four groups were (3 350.15±568.17) g, (3 318.84±523.43) g, (3 459.93±483.73) g, (3 482.27±495.30) g in order ( $P>0.05$ ). After adjusting for confounding factors through multivariate logistic regression analysis, the risk of preterm birth in group A was greater than that in group C ( $OR=0.527, 95\% CI=0.287-0.968, P=0.039$ ). Endometrial thickness did not affect the incidence of LBW, VLBW, term LBW, and SGA ( $P>0.05$ ). Further, multiple linear regression analyses indicated that body mass index, embryo transfer stage, gestation week, and newborn gender all affected the fetal birth weight ( $P<0.001, P=0.003, P<0.001, P<0.001$ ). **Conclusion** In the frozen-thawed embryo transfer cycle, the women with endometrial thickness  $\leq 8$  mm on the day of transplantation are more likely to have premature birth than women with endometrial thickness of 10–12 mm, but endometrial thickness does not affect the fetal birth weight.

**【 Key words 】** Endometrial thickness; Frozen-thawed embryo transfer; Birth weight

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# 冻融胚胎移植周期中不同辅助生殖 技术助孕方式和移植不同发育阶段 胚胎对出生性别比的影响

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【摘要】 目的 探讨冻融胚胎移植(frozen-thawed embryo transfer, FET)周期中不同辅助生殖技术(assisted reproductive technology, ART)助孕方式和移植不同发育阶段胚胎对新生儿性别的影响。方法 回顾性队列研究分析2010年4月至2018年10月期间于广州市妇女儿童医疗中心生殖中心接受体外受精(*in vitro* fertilization, IVF)、卵胞质内单精子注射(intracytoplasmic sperm injection, ICSI)和胚胎植入前遗传学检测(preimplantation genetic testing, PGT)治疗并进行FET且成功分娩的患者和新生儿临床资料。比较不同助孕方式及移植不同发育阶段胚胎对新生儿性别的影响。结果 ①IVF-FET共898对夫妇(920个周期),1166名新生儿,出生性别比为106.7。移植桑葚期前、桑葚期或囊胚期胚胎,出生性别比逐渐增高(99.0, 135.4, 142.6),但各组间差异无统计学意义( $P>0.05$ )。②ICSI-FET(含PGT)共415对夫妇(433个周期),555名新生儿,出生性别比为111.0。移植不同发育阶段胚胎,出生性别比(116.0、87.2、137.5)差异无统计学意义( $P>0.05$ )。③PGT-FET共33对夫妇(33个周期),33名新生儿,出生性别比为153.8。移植IVF、ICSI或PGT解冻囊胚对出生性别比没有显著影响( $P>0.05$ )。结论 在FET周期中,采用IVF技术助孕,移植较晚发育阶段胚胎可能会增加出生性别比的风险;ICSI技术移植不同发育阶段胚胎或移植IVF、ICSI或PGT囊胚对新生儿性别没有显著影响。

【关键词】 冻融胚胎移植; 生殖技术,辅助; 不同发育阶段胚胎移植; 出生性别比

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# Sex ratio at birth of different assisted reproductive technologies and embryo transfer at different developmental stages in frozen-thawed embryo transfer cycles

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【Abstract】 **Objective** To investigate the effect of different assisted reproductive technologies (ART) and transplanted embryos at different developmental stages on live birth sex ratio in frozen-thawed embryo transfer (FET) cycles. **Methods** From April 2010 to October 2018, the clinical data of patients and neonatal underwent *in vitro* fertilization-frozen-thawed embryo transfer (IVF-FET), intracytoplasmic sperm injection-frozen-thawed embryo transfer (ICSI-FET) and preimplantation genetic testing-frozen-thawed embryo transfer (PGT-FET) cycles that led to birth in the Center of Reproductive Medicine, Guangzhou Women and Children's Medical Center were retrospectively analyzed. The relationship of the sex ratio of the live births to different ART and transplanted embryos at different developmental stages was studied. **Results** 1) IVF-FET cycles included 898 couples (920 FET cycles) and 1166 babies, with a general sex ratio of 106.7. The live birth sex ratio increased gradually at pre-morula stage,

morula stage and blastocyst stage embryo transfer (99.0, 135.4, 142.6), but no statistical difference was observed between the groups ( $P>0.05$ ). 2) ICSI-FET cycles included 415 couples (433 FET cycles) and 555 babies, with a general live birth sex ratio of 111.0. After the transfer of embryos at different stages the proportion of male babies displayed no significant difference ( $P>0.05$ ). 3) PGT-FET cycles included 33 couples (33 FET cycles) and 33 babies, with a general live birth sex ratio of 153.8. Transplantation of blastocysts in IVF, ICSI or PGT had no significant effect on the proportion of male babies ( $P>0.05$ ). **Conclusion** In FET cycles, compared with embryo transfer at early stage, late stage embryo transfer may be associated with a higher live birth sex ratio. The transfer of ICSI-FET embryos at different developmental stages and the transfer of blastocysts by IVF, ICSI or PGT technique did not affect the sex ratio of live birth.

**【Key words】** Frozen-thawed embryo transfer; Reproductive techniques, assisted; Different developmental stage of embryo transfer; Live birth sex ratio

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## 行体外受精-胚胎移植患者的情绪 调节自我效能感与睡眠质量分析

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【摘要】 目的 调查行体外受精-胚胎移植(*in vitro* fertilization-embryo transfer, IVF-ET) 患者的睡眠质量和情绪调节自我效能感的现状,并探讨两者之间的关系。方法 采用横断面研究于2019年2月至11月在南昌大学第一附属医院生殖科选取156例进入周期的IVF-ET女性患者进行调查,采用情绪调节自我效能感量表中文版(Chinese version of the Emotional Regulation Self-efficacy Scale, RES-C)和匹兹堡睡眠质量指数(Pittsburgh Sleep Quality Index, PSQI)量表调查其情绪调节自我效能感和睡眠质量,运用Pearson相关性分析探讨两者之间的相关性。结果 156例IVF-ET患者的低睡眠质量检出率为44.9%(70/156),显著高于正常人(13.20%~33.92%);年龄、文化程度、居住地、不孕年限、是否重复周期等与低睡眠质量相关( $P=0.004$ ,  $P=0.013$ ,  $P=0.014$ ,  $P=0.007$ ,  $P=0.001$ );情绪调节自我效能感得分( $38.51\pm 8.74$ )低于常模( $45.08\pm 6.96$ )( $t=-9.360$ ,  $P<0.001$ );PSQI总分( $7.56\pm 1.81$ )显著高于常模( $2.52\pm 1.60$ )( $t=16.076$ ,  $P<0.001$ ),除催眠药物该因子外,其他各因子得分均高于常模( $P<0.001$ );情绪调节自我效能感总分与PSQI总分呈显著负相关( $r=-0.564$ ,  $P<0.001$ );情绪调节自我效能感、不孕年限和年龄对IVF-ET患者的睡眠质量有预测作用。结论 行IVF-ET患者的睡眠质量和情绪调节自我效能感偏低,临床应制定有针对性的心理干预,提高患者对情绪调控的能力,切实改善其睡眠质量,以期达到更好的助孕治疗结局。

【关键词】 受精, 体外; 胚胎移植; 情绪调节自我效能感; 睡眠质量

#### Analysis of the emotion regulation self-efficacy and sleep quality of *in vitro* fertilization-embryo transfer patients

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【Abstract】 **Objective** To investigate the status of sleep quality and regulatory emotional self-efficacy of *in vitro* fertilization-embryo transfer (IVF-ET) patients and to analyze the relationship between the two indicators. **Methods** From February to November 2019, a cross-sectional study including 156 female IVF-ET patients entering the cycle in the Department of Reproduction of the First Affiliated Hospital of Nanchang University was performed. Chinese version of the Emotional Regulation Self-efficacy Scale (RES-C) and Pittsburgh Sleep Quality Index (PSQI) were used to investigate their emotional regulation self-efficacy and sleep quality. Pearson correlation analysis was used to analyze their relationship. **Results** The detection rate of poor sleep quality in 156 patients (44.9%, 70/156) was higher than that in normal person (13.20%~33.92%). The age, education, place of residence, infertility duration, family income, occupation, repeated cycle were correlated with poor sleep quality ( $P=0.004$ ,  $P=0.013$ ,  $P=0.014$ ,  $P=0.007$ ,  $P=0.001$ ).

Emotional regulation self-efficacy score ( $38.51 \pm 8.74$ ) was lower than norm ( $45.08 \pm 6.96$ ) ( $t = -9.360$ ,  $P < 0.001$ ). The total score of PSQI ( $7.56 \pm 1.81$ ) was significantly higher than the norm ( $2.52 \pm 1.60$ ) ( $t = 16.076$ ,  $P < 0.001$ ), the score of all factors except hypnotic drugs was higher than the norm ( $P < 0.001$ ). The score of regulatory emotional self-efficacy was negatively correlated with the total score of PSQI ( $r = -0.564$ ,  $P < 0.001$ ). Emotional self-efficacy, infertility duration and age had predictive effect on sleep quality. **Conclusion** Since the sleep quality and self-efficacy of emotion regulation in IVF-ET patients are relatively low, medical staff should develop targeted psychological intervention to improve patients' ability of emotional regulation and effectively improve their sleep quality, so as to achieve better outcomes of pregnancy aid treatment.

**【Key words】** Fertilization *in vitro*; Embryo transfer; Regulatory emotional self-efficacy; Sleep quality

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## 全部胚胎冷冻患者取卵后卵巢恢复 情况及妊娠结局的相关因素分析

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**【摘要】** 目的 探究在行体外受精助孕技术中行全部胚胎冷冻的患者取卵后卵巢恢复时间及不同时间间隔后行冻融胚胎移植的妊娠结局。方法 采用前瞻性队列研究, 随访了 2017 年 7 月至 12 月期间于山东大学附属生殖医院行辅助生殖助孕技术助孕、行全部胚胎冷冻的 53 例患者, 比较取卵后第 1 次月经周期第 2~4 日血雌二醇的水平, 对比患者取卵后第 2 次月经周期的排卵情况; 并比较所有行冻融胚胎移植的患者妊娠结局的不同。结果 88.68% (47/53) 的患者在取卵后第 1 次月经第 2~4 日血雌二醇水平降至 50 ng/L 以下, 且与患者年龄 ( $\leq 30$  岁、 $> 30$  岁) ( $P = 0.161$ )、促排卵方案 (长方案、短方案、拮抗剂方案) ( $P = 0.516$ )、是否多

囊卵巢综合征 ( $P=0.661$ )、获卵数 ( $\leq 15$  枚、 $>15$  枚) ( $P=0.671$ ) 无关。非多囊卵巢综合征且既往月经规律的患者中, 76.00% (19/25) 的患者在取卵后第 2 个月经周期已恢复排卵, 中位排卵时间为月经第 16 日。取卵后第 2 次月经后移植与取卵后第 3 次月经及以后移植的患者妊娠结局差异无统计学意义, 其中多囊卵巢综合征患者与非多囊卵巢综合征患者的妊娠结局差异无统计学意义 ( $P>0.05$ )。结论在行体外受精助孕技术中取卵后行全部胚胎冷冻的患者, 如无禁忌, 可尽早移植冻融胚胎。

【关键词】 胚胎冷冻; 胚胎移植; 雌二醇; 排卵; 妊娠结局

# **Study of ovarian recovery time after oocyte retrieval and the relationship between pregnancy outcomes and embryo transfer time in patients who undergo freeze-all strategy**

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**【Abstract】 Objective** To explore the recovery time of ovary in patients who underwent all embryo freezing after oocyte retrieval in *in vitro* fertilization (IVF) and the relationship between pregnancy outcome and embryo transfer time. **Methods** This research included 53 patients who underwent all embryos freezing in the Reproductive Hospital of Shandong University from July to December in 2017. The baseline level of serum estradiol in the first menstrual cycle after oocyte retrieval and the ovulation time during the second menstrual cycle after oocyte retrieval was assessed in 53 patients. In addition, the pregnancy outcomes of all patients underwent frozen-thawed embryo transfer were followed up. **Results** During the second to the fourth day of the first menstrual cycle after oocyte retrieval, 88.68% (47/53) of the patients had a blood estradiol level below 50 ng/L, which had no relationship with the age of the patients ( $\leq 30$  years old,  $>30$  years old) ( $P=0.161$ ), the method of ovulation induction ( $P=0.516$ ), with or without polycystic ovary syndrome ( $P=0.661$ ), the number of oocyte obtained ( $\leq 15$ ,  $>15$ ) ( $P=0.671$ ). Among patients without polycystic ovary syndrome and regular menstrual cycle, 76.00% (19/25) of patients had recovered ovulation in the second menstrual cycle after oocyte retrieval, and the median ovulation time was the 16th day of menstruation cycle. There was no significant difference in the pregnancy outcomes between patients who had embryo transfer during the second menstrual cycle and patients who had embryo transfer during the third menstrual cycle or later ( $P>0.05$ ). **Conclusion** It is rational to transfer embryo earlier for patients who underwent all embryo freezing after oocyte retrieval in IVF.

**【Key words】** Frozen embryo; Embryo transfer; Estradiol; Ovulation; Pregnancy outcome

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## 体外受精-胚胎移植后宫内妊娠合并子宫肌壁间妊娠 1 例文献分析

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**【摘要】** 目的 探讨体外受精-胚胎移植 (*in vitro* fertilization-embryo transfer, IVF-ET) 术后发生宫内妊娠合并子宫肌壁间妊娠诊断、治疗及预防方法。方法 回顾分析 1 例 IVF-ET 术后宫内妊娠合并子宫肌壁间妊娠诊疗经过并进行文献复习。结果 患者冷冻移植 2 枚胚胎后妊娠, 孕 40 d, B 超示宫内早孕合并右侧宫角肌层内妊娠, 于西北妇女儿童医院行腹腔镜下子宫肌壁间妊娠清除术, 术后宫内妊娠给予加强保胎治疗, 现患者孕 20 周, 宫内单胎妊娠。结论 IVF-ET 患者行多胚胎移植增加异位妊娠风险; IVF-ET 术后宫内妊娠合并子宫肌壁间妊娠治疗方式应结合患者临床表现、辅助检查结果和患者自身意愿。

**【关键词】** 子宫肌壁间妊娠; 受精, 体外; 胚胎移植; 宫内合并宫外妊娠

基金项目: 西安市科技局科技计划项目 (20YXYJ0005 (9))

### Intrauterine pregnancy with intramural pregnancy after *in vitro* fertilization-embryo transfer: a case report and literature review

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**【 Abstract 】** **Objective** To investigate the diagnosis, treatment and prevention of intrauterine pregnancy with intramural pregnancy (IMP) after *in vitro* fertilization-embryo transfer (IVF-ET). **Methods** A retrospective clinical study and literature review were performed to analyze one intrauterine pregnancy with intramural pregnancy after IVF-ET. **Results** After double embryo transfer, the patient got conceived. Ultrasound showed early pregnancy in utero with intramural pregnancy on the 40th day of her pregnancy. So the patient underwent

laparoscopic hysterectomy in Northwest Women's and Children's Hospital. The patient is now 20 weeks pregnant, and has a intrauterine singleton pregnancy.

**Conclusion** IVF-ET increases the risk of ectopic pregnancy. The treatment of intrauterine pregnancy with intramural pregnancy should take clinical manifestations, examination results and the patient's own wishes into account.

**【Key words】** Intramural pregnancy; Fertilization *in vitro*; Embryo transfer; Heterotopic pregnancy

**Fund program:** Xi'an Science and Technology Bureau (20YXYJ0005(9))

## · 个案报道 ·

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# 辅助生殖助孕取卵前卵巢扭转 1 例报道及分析

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**【摘要】** 目的 探讨辅助生殖技术治疗时发生卵巢扭转的时机、诊断和治疗方法。方法 对郑州大学第二附属医院生殖中心收治的 1 例取卵前卵巢扭转患者的临床资料进行回顾性分析并复习相关文献。结果 患者取卵前一天突然下腹痛, 经阴道多普勒超声提示卵巢扭转, 经阴道穿刺减压无效时及时行腹腔镜手术复位固定, 保留了卵巢。结论 卵巢体积中等增大是卵巢扭转的高危因素, 临床表现无特异性, 诊断以阴道多普勒超声为准, 及时进行腹腔镜下扭转复位并固定可避免卵巢坏死切除, 并可防止术后复发, 值得临床应用。

**【关键词】** 生殖技术, 辅助; 卵巢过度刺激综合征; 卵巢扭转

基金项目: 郑州市科技惠民计划 (2019KJHM0008)

## A case report and analysis of ovarian torsion before oocyte retrieval of assisted reproduction

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**【 Abstract 】 Objective** To explore the opportunity, diagnosis and treatment of ovarian torsion in assisted reproductive technology. **Methods** The clinical data of a case of ovarian torsion before oophorectomy in the Reproductive Center of the Second Affiliated Hospital of Zhengzhou University were analyzed retrospectively and the relevant literatures were reviewed. **Results** The patient had a sudden hypogastralgia on the day before oocyte retrieval, and the ovarian torsion was indicated by transvaginal Doppler ultrasound. When the transvaginal puncture decompression was ineffective, laparoscopic surgery was performed in time to restore and fix the ovary. **Conclusion** The increase of ovarian volume is a high risk factor for ovarian torsion, and its clinical manifestations are nonspecific. The diagnosis is based on vaginal Doppler ultrasound. Timely reduction and fixation of the torsion under laparoscope can avoid ovarian necrosis resection and prevent postoperative recurrence, which is worthy of clinical application.

**【 Key words 】** Reproductive technology, assisted; Ovarian hyperstimulation syndrome; Ovarian torsion

**Fund program:** Science and Technology Benefiting People Plan of Zhengzhou (2019KJHM0008)

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## 胰岛素抵抗对辅助生殖助孕结局影响的研究进展

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**【摘要】** 在通过辅助生殖技术(assisted reproductive technology, ART)助孕治疗的不孕症患者中,部分患者合并胰岛素抵抗(insulin resistance, IR),

且 IR 影响 ART 助孕结局，这可能是胚胎反复种植失败 ( repeated implantation failure , RIF ) 的原因之一。本文就 IR 对辅助生殖助孕结局影响的研究进展做一综述，为 IR 引起的 RIF 的治疗提供理论依据。

【关键词】 胰岛素抵抗； 胚胎种植； 卵母细胞； 子宫内膜容受性

基金项目：云南省中青年学术和技术带头人后备人才 ( 2017HB041 ) ；云南省基础研究计划重点项目 ( 2018FA009 ) ；国家自然科学基金 ( 81660266 ) ；国家重点研发计划 ( 2018YFC1002106 )

## Research progress on the impact of insulin resistance on the outcome of assisted reproductive technology

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【Abstract】 Among infertile patients treated with assisted reproductive technology (ART), some patients have insulin resistance (IR), and IR affects the outcome of ART, which may be one of the reasons of repeated implantation failure (RIF). This article aims to provide an overview of the research progress on the impact of IR on assisted reproduction, and provide a theoretical basis for the treatment of RIF caused by IR.

【Key words】 Insulin resistance; Embryo implantation; Oocytes; Endometrial receptivity

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## 冻融卵巢组织移植后促血管生成研究进展

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**【摘要】** 卵巢组织冷冻和移植技术对于保存女性生育力具有重要作用。但冻融卵巢组织移植后的缺血损伤，是移植卵巢组织存活和生殖内分泌功能恢复的关键问题。适宜的卵巢组织冷冻和移植技术，及添加促血管生成因子、激素、抗氧化剂、中药等能有效促进冻融卵巢组织移植后的血管生成，提高卵巢组织移植后卵泡成活率和生殖功能恢复效果。本文就冻融卵巢组织移植后缺血损伤的发生以及如何促进血管再生相关内容进行综述。

**【关键词】** 卵巢； 低温保存； 移植； 血管生成

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## Research progress on pro-angiogenesis after frozen-thawed ovarian tissue transplantation

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**【 Abstract 】** Ovarian tissue cryopreservation and transplantation technology plays an important role in preserving female fertility. However, the ischemic injury after frozen-thawed ovarian tissue transplantation is a key issue for the survival of the transplanted ovarian tissue and the restoration of reproductive endocrine function. The use of appropriate ovarian tissue cryopreservation and transplantation techniques, or the addition of angiogenic factors, hormones, antioxidants, and Chinese medicine can effectively promote the angiogenesis of frozen-thawed ovarian tissue after transplantation, and improve the survival rate of follicles and the recovery of reproductive function. This article reviews the occurrence of ischemic injury after frozen-thawed ovarian tissue transplantation and how to promote angiogenesis.

**【Key words】** Ovary; Cryopreservation; Transplantation; Angiogenesis

**Fund program:** Key Program of Science and Technology Department of Sichuan Province (2018JY0050); Key Program of Education Department of Sichuan Province (18ZA0155)

## · 综 述 ·

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## 干细胞治疗卵巢早衰研究进展

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**【摘要】** 早发性卵巢功能不全 (premature ovarian insufficiency, POI) 也被称为卵巢早衰，作为女性不孕症的主要原因之一，受到广泛关注，主要表现为低雌激素水平和高促性腺激素水平。POI 的病因及机制复杂，目前无统一论，在治疗上也主要采用补充雌激素等综合治疗。随着干细胞研究的深入，干细胞治疗 POI 成为新的关注点，本文对 POI 的病因及不同来源干细胞治疗 POI 的作用机制做一综述，为后续的研究提供参考。

**【关键词】** 干细胞；间充质干细胞；早发性卵巢功能不全；卵巢早衰

### Advances in stem cell therapy for premature ovarian failure

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**【Abstract】** Premature ovarian insufficiency (POI) is also known as premature ovarian failure, as one of the main causes of female infertility, and has been widely concerned, mainly manifested by low estrogen levels and high gonadotropin levels. The etiology and mechanism of POI are complex, and there is no consensus at present. With the deepening of stem cell research, stem cell therapy for POI has become a new focus. This paper summarizes the etiology of POI and the mechanism of action of stem cell therapy for POI from different sources, providing reference for future research.

**【Key words】** Stem cells; Mesenchymal stem cells; Premature ovarian insufficiency; Premature ovarian failure

·综述·

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## 诱导多能干细胞体外分化为雄性生殖细胞的研究进展

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**【摘要】** 男性不育是影响生殖健康的重要问题, 由于致病因素和发病机制复杂, 临床上针对非梗阻性无精子症等不明原因的男性不育症往往缺乏特异性治疗措施。随着生殖细胞体外诱导培养的技术的发展, 研究者们希望利用无精子症患者源性的多能干细胞体外培养出自身具有功能性的精子, 从而治疗男性不育症。体外培养生殖细胞的策略, 通常是先将诱导多能干细胞分化为原始生殖样细胞, 然后进一步诱导分化为单倍体精子样细胞, 其培养的难点在于将二倍体生殖细胞减数分裂为单倍体的精细胞, 但是目前这个问题还没有得到解决。我们对诱导多能干细胞诱导雄性配子的技术进展和原理进行综述, 希望能帮助我们更好地理解体外精子发生的机制, 为体外受精的临床应用提供参考。

**【关键词】** 多能干细胞; 雄性生殖细胞; 精子发生; 诱导分化

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### Research progress in differentiation of male germ cells derived from induced pluripotent stem cells *in vitro*

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**【 Abstract 】** Male infertility is an important issue affecting reproductive health, and its etiology and mechanism are complex or not clear. For patients with azoospermia, specific clinical treatments are limited. Therefore, to generate patients' own functional sperms is absolutely necessary. With the development of techniques, the scientists start to think about how to attain functional sperms deriving from human induced pluripotent stem cells (iPSCs) *in vitro*. Mainly, sperm induction with iPSCs includes two steps, first, the formation of diploid primordial germ cell, then the differentiation of haploid mature sperms. Technically, the difficulties lie in the generation of meiosis from a diploid cell into haploid sperm, and unfortunately, the problem is not solved yet. In order to understand this kind of knowledge well, we try to review the technical progress and principle of male gamete induction from iPSCs. Hopefully, it can help us to understand the mechanism of spermatogenesis *in vitro* well, and to provide a reference for the clinical application of *in vitro* fertilization.

**【 Key words 】** Pluripotent stem cells; Male germ cells; Spermatogenesis; Differentiation *in vitro*

**Fund program:** Henan Science and Technology Department (192102310134); Open Project of National Health Commission Key Laboratory of Birth Defect Prevention (ZD201903)