ORIGINAL ARTICLE: ASSISTED REPRODUCTION

Optimal polar bodies angle for higher subsequent embryo viability: a pilot study

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Objective: To determine the optimal polar bodies (PB) angle for higher subsequent embryo implantation potential.
Design: Prospective study.
Setting: Academic fertility center.
Patient(s): From January to July 2015, 116 patients were recruited in their first IVF-ET cycles.
Intervention(s): At the pronuclear stage, PB angle was measured with the use of E-ruler 1.1.
Main Outcome Measure(s): The primary outcome measure was good-quality embryo rate. Secondary measures were clinical pregnancy rate (CPR) and embryo implantation rate (IR).
Result(s): A total of 1,103 oocytes were retrieved. PB angle was measured in 454 zygotes, and 164 of their subsequent embryos were transferred into the uterus. All-or-none implantation took place in 129 embryos, and 89 patients accepted fresh embryo(s) transfer with known PB angle. By means of receiver operating characteristic analysis, the optimal PB angle for subsequent embryo implantation was 24.25°. Based on this cutoff value, 454 zygotes were divided into two groups: small-angle and large-angle. A higher percentage of small-angle zygotes developed into good-quality embryos (70.97% vs. 58.58%). CPR and IR both decreased progressively from purely small-angle embryos to mixed embryos to purely large-angle embryos (CPR: 72.41% vs. 38.46% vs. 26.47%, respectively; IR: 63.27% vs. 26.92% vs. 16.67%, respectively).
Conclusion(s): Noninvasive assessment of PB angle is a viable technique for zygote selection and should be included in embryo selection parameters.
Clinical Trial Registration Number: Clinical Trial Registration Number: ChiCTR-OOC-15005882. (Fertil Steril® 2015;■:■–■. ©2015 by American Society for Reproductive Medicine.)
Key Words: Polar bodies, embryo polarity, embryo morphology, implantation

Over the past decade, an increasing amount of evidence suggests that the animal-vegetal axis formed during meiotic maturation in human oocytes has an effect not only on meiosis itself or on fertilization but also on further embryo development. Oocyte polarization is an early manifestation of gradients providing positional information to the cell throughout fetal growth. The animal pole of the oocyte is estimated by the location of the first polar body (PB1), whereas the second polar body (PB2) is extruded after fertilization (1–3). Several studies have shown that, on average, PB1 is not located near to the meiotic spindle (4–7) where the PB2 extrudes some distance away from the PB1. The relative distance between PB1 and PB2 has also been proven to negatively affect subsequent embryo quality (8, 9).

In human in vitro fertilization (IVF), cleaving embryos are usually allocated a morphologic grade that takes into account the preembryo pronuclear (PN) morphology (Z-scoring), the presence of multinucleation, cytoplasmic irregularities, the number of blastomeres, the percentage of fragmentation, and the development of the blastocyst (10, 11). However, the polar bodies angle (PB angle), defined as the angle derived from the oocyte center to the two PBs (Fig. 1), is rarely assessed. Several studies have demonstrated that an evaluation of PB angle provides important clues for the selection of viable embryos and has a high predictive value for the presence of complex chromosomal abnormalities (8, 9). Because the relationship between PB angle and embryo viability is still unknown, the purpose of the present study was to

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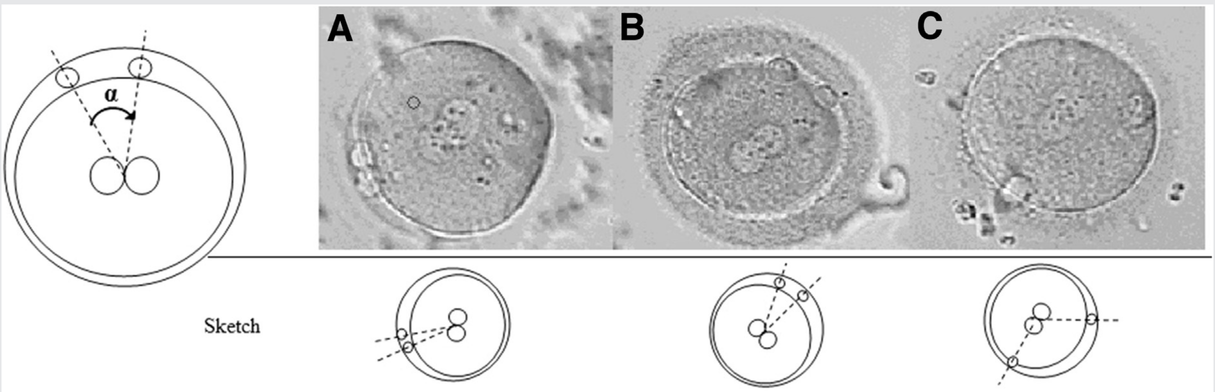
FIGURE 1



	A	B	C
Z-scoring	Z2	Z2	Z2
PB angle	16.32°	38.13°	124.61°
Embryo grade on Day-3	A	A	A
Embryo implantation	success	failure	failure

The schematic diagram of polar body (PB) angle measurement, subsequent embryo quality and implantation outcome. Lines were drawn to connect the oocyte geometric center of the zygote with the two PBs. PB angle (α) was subtended by the two lines. The PB angles of the three zygotes are **(A)** 16.32°, **(B)** 38.13°, and **(C)** 124.61°, respectively from left to right. Their subsequent embryos quality were all grade A on day 3. After transfer, only the leftmost embryo implanted successfully.

Zhang. Optimal polar bodies angle. Fertil Steril 2015.

determine the optimal PB angle for higher subsequent embryo implantation potential.

MATERIALS AND METHODS

Study Setting and Patients

A pilot study was conducted at the Center for Reproductive Medicine at Xiang-Ya Hospital in Changsha, Hunan, People's Republic of China. This prospective study was approved by the Reproductive Medicine Ethics Committee of Xiangya Hospital (approval no. 201411396) and was registered in the Chinese Clinical Trial Registry (trial registration no. ChiCTR-OOC-15005882). From January to July 2015, a total of 116 patients were recruited. The study protocol was explained to the participants in detail, and a signed consent was obtained from each patient.

Inclusion Criteria

Inclusion criteria included age <40 years, normal ovarian response, and body mass index (BMI) of 18–25 kg/m^2. Participants were also required to be on their first IVF cycle with tubal factor as the main indication for treatment.

Exclusion Criteria

Participants were excluded for the following reasons: severe hydrosalpinx; advanced endometriosis (stage III–IV); uterine adhesion, myoma, or adenomyosis adjacent to uterine cavity; use of intracytoplasmic sperm injection (ICSI) or rescue ICSI; and poor-quality embryos.

Ovarian Stimulation and Embryo Transfer

Induction of multiple follicular growth was accomplished with the use of administration of exogenous highly purified (hp) FSH (Lishenbao) after a long desensitization protocol with short-acting GnRH agonist (triptorelin; Ferring). After hCG administration, oocytes were transvaginally collected. To enable individual follow-up of embryo development, oocytes were cultured separately in IVF medium (G-series culture media; Vitrolife).

Embryo quality was comprehensively assessed by two embryologists blinded to PB assessment and with the use of both preembryo PN morphology (Z-score) at the time of fertilization evaluation and cleavage-stage embryo morphology (10, 11). Embryo selection for transfer was performed according to the following criteria: development to ≥6 equal blastomeres, <25% fragmentation, and absence of multinucleation. PB angle was not considered as a factor for selection. Cleavage-stage embryos were evaluated according to the Asociación para el Estudio de la Biología de la Reproducción embryo assessment criteria (12). On day 3 after oocyte retrieval, up to two good-quality (grade A or B) cleavage-stage embryos were transferred with the use of ultrasound guidance.

Clinical pregnancy was defined as the presence of a gestational sac with or without fetal heart activity as evaluated