

Short Communication

Comparison of Embryo Development in Time-Lapse (Geri) and Benchtop Conventional Incubators: A Prospective Sibling Oocyte Study

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- Conventional Incubator
- Embryo Development
- Blastocyst Quality
- Euploidy Rate
- IVF

Abstract

Study Question: Does the use of a time-lapse incubator (Geri) improve embryo development and blastocyst quality compared to a conventional Benchtop incubator?

Summary Answer: Embryos cultured in the time-lapse Geri incubator demonstrated significantly higher blastulation rates, improved blastocyst quality, and increased euploidy rates compared to those cultured in a conventional benchtop incubator.

What is Known Already: Conventional benchtop incubators have been the standard in IVF laboratories, but time-lapse incubators offer continuous monitoring with minimal environmental disturbance, potentially improving embryo development and selection.

Study Design, Size, Duration: This prospective sibling oocyte study included 3,079 mature oocytes from 200 patients undergoing ICSI at ART Fertility Clinics, Antalya, Türkiye, between June 2023 and January 2024. Oocytes were randomly allocated to either the Geri time-lapse incubator or a conventional benchtop incubator (G185 K-SYSTEMS).

Participants/Materials, Setting, Methods: A total of 1,372 oocytes were cultured in the Geri incubator, and 1,707 in the conventional incubator. Fertilization, cleavage, blastocyst formation, and embryo quality were assessed. Blastocyst euploidy rates were determined using preimplantation genetic testing for aneuploidy (PGT-A).

Main Results and the Role of Chance: No significant differences were observed in fertilization rates (64.0% vs. 58.4%, $P = 0.932$) or cleavage rates (44.4% vs. 41.3%, $P = 0.676$) between the two groups. However, embryos cultured in the Geri incubator had significantly higher blastulation rates (54.0% vs. 50.0%, $P < 0.001$) and usable blastocyst rates on Day 5 (56.8% vs. 49.0%, $P = 0.036$). Additionally, the Geri group showed a significantly higher euploidy rate (53.5% vs. 36.4%, $P = 0.001$) and improved blastocyst quality ($P = 0.007$).

Limitations, Reasons for Caution: The study was conducted at a single center, and the sample size, though substantial, may not fully capture variability across different patient populations. Additionally, the cost-effectiveness of time-lapse incubators was not evaluated.

Wider Implications of the Findings: The results suggest that time-lapse incubators, such as the Geri, may enhance embryo development and selection, potentially improving IVF outcomes. These findings support the adoption of time-lapse technology in IVF laboratories, particularly for clinics aiming to optimize blastocyst quality and euploidy rates.

Study Funding/Competing Interests: This study was funded by ART Fertility Clinics. The authors declare no competing interests.

INTRODUCTION

The culture environment is a critical determinant of embryo development in assisted reproductive technology (ART). Traditional benchtop incubators have been widely used in IVF laboratories due to their reliability and simplicity. However, their inability to provide real-time monitoring of embryo development may limit the precision of embryo selection. In contrast, time-lapse incubators, such as the Geri (Genea), offer continuous

imaging of embryos, enabling embryologists to monitor developmental milestones without disturbing the culture environment. This study aims to compare the developmental outcomes of embryos cultured in a time-lapse Geri incubator versus a conventional benchtop incubator, with a focus on fertilization, cleavage, blastocyst formation, and embryo quality.

The introduction of time-lapse technology in ART has revolutionized the way embryologists assess and

select embryos. By providing uninterrupted monitoring of embryo development, time-lapse incubators minimize the need for manual handling, thereby reducing the risk of environmental stress on embryos. This study builds on previous research demonstrating the benefits of time-lapse imaging in improving embryo selection and developmental outcomes [1,2]. However, there remains a need for large-scale, prospective studies to validate these findings and explore the broader implications of time-lapse technology in clinical practice.

MATERIALS AND METHODS

Study Design and Participants

This prospective sibling oocyte study included 200 patients undergoing ICSI at ART Fertility Clinics, Antalya, Türkiye, between June 2023 and January 2024. A total of 3,079 mature oocytes were randomly allocated to either the Geri time-lapse incubator ($n = 1,372$) or a conventional benchtop incubator ($n = 1,707$).

Culture Conditions

- **Geri Time-Lapse Incubator:** Equipped with continuous imaging capabilities, the Geri incubator provided a stable environment with minimal disturbances.
- **Conventional Benchtop Incubator:** The G185 K-SYSTEMS incubator was used as the control, with periodic manual assessments of embryo development.

Outcome Measures

Fertilization, cleavage, blastocyst formation, and embryo quality were assessed. Blastocyst euploidy rates were determined using PGT-A.

Statistical Analysis

Data were analyzed using chi-square and t-tests, with $P < 0.05$ considered statistically significant.

RESULTS

1. **Fertilization and Cleavage Rates:** No significant differences were observed between the two groups ($P > 0.05$).
2. **Blastocyst Formation:** The Geri group had significantly higher blastulation rates (54.0% vs. 50.0%, $P < 0.001$) and usable blastocyst rates on Day 5 (56.8% vs. 49.0%, $P = 0.036$).
3. **Euploidy Rates:** The Geri group demonstrated a

significantly higher euploidy rate (53.5% vs. 36.4%, $P = 0.001$).

4. **Embryo Quality:** Blastocyst quality was significantly improved in the Geri group ($P = 0.007$).

DISCUSSION

This study highlights the advantages of time-lapse incubators in supporting embryo development. The continuous monitoring and minimal disturbance provided by the Geri incubator likely contributed to the observed improvements in blastocyst formation, euploidy rates, and embryo quality. These findings align with previous studies demonstrating the benefits of time-lapse technology in AR [1,2].

The higher blastocyst quality and euploidy rates in the Geri group suggest that time-lapse incubators may enhance the selection of viable embryos, potentially improving IVF success rates. However, the cost and accessibility of time-lapse technology remain important considerations for IVF clinics.

The findings of this study are consistent with those of [3], who reported that time-lapse imaging allows for the identification of morphokinetic parameters predictive of blastocyst formation and quality. Similarly [4], demonstrated that non-invasive imaging techniques, such as those employed by time-lapse incubators, can predict embryo development with high accuracy.

Moreover, the improved euploidy rates observed in the Geri group are particularly noteworthy. Aneuploidy is a major cause of implantation failure and miscarriage in ART, and the ability to select euploid embryos is critical for improving IVF outcomes. The findings of this study support the use of time-lapse technology as a tool for enhancing embryo selection and reducing the risk of aneuploidy [5,6-10].

Despite these promising results, it is important to acknowledge the limitations of this study. The single-center design and relatively homogeneous patient population may limit the generalizability of the findings. Additionally, the study did not evaluate the cost-effectiveness of time-lapse incubators, which is an important consideration for IVF clinics. Future research should address these limitations by conducting multicenter studies with diverse patient populations and incorporating cost-benefit analyses.

CONCLUSION

The use of the Geri time-lapse incubator resulted in significantly improved blastocyst formation, euploidy

rates, and embryo quality compared to a conventional benchtop incubator. These findings support the adoption of time-lapse technology in IVF laboratories to optimize embryo development and selection. Future studies should explore the long-term clinical outcomes and cost-effectiveness of time-lapse incubators in ART.

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