The Embryoscope:

A revolutionary tool for monitoring embryo development and treatment outcomes.

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Background

The introduction of artificial intelligence in embryo monitoring and development has introduced a lot of flexibility in the areas of accuracy and reproducibility of data, embryo selection, minimising inter and intra observer variation that has not necessarily been matched by an evidence based improvement in outcomes.

While Gardner grading provides standardized assessments of Inner Cell Mass (ICM) and trophectoderm (TE), Time-lapse imaging (TLI) provides continuous, undisturbed monitoring of embryo development, offering more detailed morphokinetic data and a more stable environment.

Figure 1 - Embryoscope

Introduction

The Embryoscope is a specialized embryo incubator in IVF clinics that utilizes time-lapse imaging technology to continuously monitor embryo development. It allows for non-interrupted observation and video recording of embryo development without removing the embryos from their controlled environment, thus minimizing stress. This allows embryologists to monitor embryos in real-time and select the best ones for transfer, potentially improving IVF success rates.

We review and critically appraise available evidence using key performance metrics:

- Fertilization rate
- Embryo quality on day 3 and 5 of culture and
- clinical pregnancy rates.

Discussion

Traditional embryo monitoring involves assessing embryos at discrete time intervals by removing them from the incubator for microscopic examination. This approach can be limited by the disruption to the embryo's environment and incomplete data on continuous changes.

Risks include disturbing the embryos by frequent handling; lack of continuous monitoring to track natural development; and human error in assessment.

The embryoscope, using time lapse morphokinetics capturing images at predetermined intervals (every 10 - 20 minutes), provides continuous non-invasive monitoring without removing the embryos, ensuring the embryos remain undisturbed.

High-resolution photos provide clear detailed images of embryos, while automated operations reduce human error in assessment and allow for objective analysis in a stable culture environment (temperature, gas, humidity).

The embryoscope is equipped with a camera and incubator. Embryos are cultured in a controlled, temperature-stable environment. High resolution images of the embryos are taken at intervals and then catalogued to form a video of each embryos development. Cell division and morphology of the inner cell mass (ICM) and trophoectoderm are morphokinetically determined using artificial intelligence.

The embryoscope enables improved embryo selection by identifying embryos with the best developmental potential. By analyzing the developmental behavior and speed of cell division, embryologists can choose embryos with the best chance of successful implantation.

This continuous monitoring allows for a more detailed observation of cell division and overall development, helping embryologists identify the most viable embryos for transfer.

The embryoscope minimizes the need for frequent handling of embryos, reducing the risk associated with removing them from the incubator for inspection.

Embryoscopes reduce the workload of laboratory personnel by automating the monitoring process and minimizing the need for manual inspection, thus making efficient use of laboratory resources.

Study 1

Sibling oocytes cultured in time lapse versus bench top incubator: how time lapse improves blastocyst deveolpment and euploid rate.

Objective:

To determine whether limited exposure of embryos outside the incubator has an effect on embryo development, blastocyst quality and euploid outcomes.

Study design: Retrospective cohort

Methodology:

Seven hundred and ninety six sibling oocytes were split randomly between two incubators after intracytoplasmic sperm injection: an embryoscope incubator and a conventional benchtop incubator, G185 K-SYSTEMS (KS)

Five hundred and three 503 (63.2%) oocytes were cultured in the embryoscope and 293 (36.8%) were cultured in the K-SYSTEMS

Outcome measures:

Fertilization rates, cleavage/embryo quality, useable blastocyst and euploid rates.

Key findings:

No statistically significant difference in fertilization rates (79.3 % vs 78.8%) P=0.932, clevage rate (98.5% vs 99.1%) P= 0.676 and embryo quality on day 3 (P=0.543) between the incubators.

However embryos cultured in the embryoscope had a higher chance of being biopsied (64.8% vs 49.6 %) P< 0.001

A higher blastocyst biopsy rate on day 5 (67.8% vs 57.0 %) P=0.037, euploid rate (63.5% vs 37.4%) P=0.001 and blastocyst quality P =0.008 were observed in the embryoscope group.

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Study 2

Impact of time lapse incubator systems on fertilization, blastocyst development and clinical pregnancy outcomes

Objective:

To compare time lapse culture system and conventional incubator on IVF outcome.

Methodology:

Four thousand seven hundred and sixty nine (4769) infetrile couples were undergoing IVF. The participants were categorized into two groups depending on embryo culture system. Two thousand one hundred and eighty four (2184) were assigned to the time lapse incubator(TLI) and 2585 were assigned to the conventional incubator group.

Outcome measures:

Fertilization rate, blastocyst quality on day 3 and day 5, clinical pregnancy rate.

Key findings:

Statistically significant difference fertilization rate, blastocyst quality and $P < 0.001$ between the TLI and the conventional incubator group.

Clinical pregnancy rates were similar 45.7% for TLI vs 41.1 % for the CI group P=0.169.

Conclusion

Exposure of embryos outside the incubator may negatively affect blastocyst formation rate and euploid rate on day 5.

However this does not necessarily translate to significant changes in clinical outcomes.

Recommendation

Use of the embryoscope should be incorporated into our culture protocol as it may help improve embryo selection and increase the chances of implantation and pregnancy.

References

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