Abstract Details

Session title: Session 02: New insights into embryo development
Session type: Selected oral communications
Presentation number: O-007

Abstract title:

Association of successful embryo development and pregnancy outcome with redox state as measured by human non-mercaptalbumin in embryo culture medium

Biography

Yoshika Kusumoto is an IVF laboratory director in Sakurajyuji Women's Clinic (in Tokyo) with 13 years of experience as an embryologist. While working at the clinic as an embryologist, he also engages in research on oxidative markers and clinical medicine at the University of Tokyo Hospital. He is interested in improving clinical outcomes and its factors affecting.

Y. Kusumoto[1,2,3], M. Sato[3,4], K. Yasukawa[3,], B. Uranbileg[3,], H. Ikeda[3,], Y. Yatomi[3,].
[1]Sakurajyuji Women's Clinic Shibuya, Culture section, Tokyo, Japan.
[2]Akihabara ART Clinic, Culture section, Tokyo, Japan.
[3]The University of Tokyo, Department of Clinical Laboratory Medicine- Graduate School of Medicine, Tokyo, Japan.
[4]The University of Tokyo, Department of Gastroenterology- Graduate School of Medicine, Tokyo, Japan.

Study question:

Is the redox state in the embryo culture medium, as measured by oxidized albumin, associated with successful embryo development and pregnancy outcome?

Summary answer:
The level of oxidized albumin in the culture medium was the most important variable in predicting blastocyst formation andwas associated with miscarriage after transfer.

What is known already:
Human serum albumin (HSA), the most abundant protein in the plasma, exerts important antioxidant activities against oxidative damage. HSA exists as oxidized human non-mercaptalbumin (HNA) and reduced human mercaptalbumin. HNA is attracting attention because of its novel role as a marker reflecting oxidative state, and HNA levels are known to increase in oxidative stress diseases such as kidney disease, diabetes, liver disease or Parkinson's disease. On the other hand, in human IVF, most culture medium are supplemented with HSA as a protein source, but no previous studies have examined the relationship between HNA and IVF outcomes.

Study design, size, duration:
We followed the pregnancy outcomes for 40 cycles of single blastocyst transfer out of the retrospective study, which enrolled a total of 173 embryos cultured to the blastocyst stage from a total of 91 patients who underwent IVF/ICSI cycle between February 2018 and July 2018.

Participants/materials, setting, methods:
Prior to using the medium for embryo culture, the redox state was assessed with HNA level. HNA level, patient age, IVF/ICSI and oocyte maturity were analyzed as factors associated with blastocyst formation on day 5 and 6 after fertilization, and a machine learning model was developed by using the Random Forest (RF) algorithm to predict blastocyst formation. We also examined whether the factors made a difference in pregnancy outcomes.

Main results and the role of chance:

The median %HNA in the culture medium was 89.36% (range, 80.12% to 94.84%), which was much higher than the value for blood in healthy humans, (approximately 25%). Blastocyst formation was observed in 41.04% (71/173) embryos. In both univariate and multivariate analyses, successful blastocyst development was associated with a lower %HNA in the culture medium ($p=0.001$), a younger patient age ($p<0.001$), and the use of standard IVF ($p=0.007$). A prediction model for successful blastocyst formation was developed using a RF algorithm with four factors (%HNA, patient age, fertilizationmethod, and oocyte maturation stage). The RF model developed using 70% of samples (training set, n = 121) was validated in the remaining testing set (n = 52) and produced an area under the curve of 0.761, where %HNA in the culture medium was the most important variable for the prediction of blastocyst formation, followed by patient age. The HNA levels were significantly higher in the group of embryos that resulted in miscarriage after blastocyst transfer (93.15% vs. 89.28%, P =0.0498).

Limitations, reasons for caution:
This study was conducted in G-TL medium only. Further studies are needed to elucidate the association of %HNA and embryo development, and to predict the transfer success rate by using other commonly used media.

Wider implications of the findings:
In the IVF medium, which is supposed to mimic the body environment, the %HNA showed a high oxidized state compared to the body itself; it is suggesting it may cause unsuccessful IVF results and lower live birth rate. Controlling the oxidation level may help to create a more appropriate environment.

Keywords:
Machine Learning
culture medium
human non-mercaptalbumin
oxidative stress
IVF outcomes