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Research on the relationship between the capacity of embryo storage tanks and the estimated embryo salvage period when tanks are damaged.

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Objective

Keeping liquid nitrogen (LN2) tank properly is extremely important for an ART clinic. As the accident in the U.S. in 2018 showed, a tank failure causes serious damage for embryos and patients. However, there's no detailed information as to what to do when tanks are damaged. In our previous study, we indicated that a damaged 10L tank can keep freezing for 7-8 hours if it retains a certain level of LN2. In this study, we analyzed the influence of tank capacity on the estimated embryo salvage period in a simulated tank failure.

Study design

Prospective experimental trial.

Materials & Methods

We prepared 3 tanks of different capacity (XT10, HC20, HC35, Taylor Wharton, USA). All

tanks were filled up to full with LN2. To simulate tank failure, we drilled a 2mm diameter hole in the vacuum valve of each tank. A temperature probe was set in a plastic sleeve of cane in the tanks. We measured the temperature and LN2 levels every 15 min for the first hour. Then, they were measured every hour until the rise in temperature began. After the temperature initiated to rise, they were measured every 15 min until the temperature reached 80 °C, which is the temperature at which embryos start to get damaged. Before tank failure simulation, temperatures and LN2 level of each tank were measured every 24 hours for 7 days to see the temperature and LN2 volume shift without tank damage.

Results

Speed of LN2 level decrease of the 10, 20 and 35L tank was 4.6, 4.5, and 2.8 cm/h, respectively. The temperature at the start of measurement for all tanks was 196°C . In the 10L tank, the rise in temperature began when the remaining LN2 level was 1cm. In the 20 and 35L tanks, it began when the LN2 was gone. The time at which the rise in temperature began was 6h45min for the 10L tank, 8h00min for the 20L tank, and 11h45min for the 35L tank, respectively. The time it took for the temperature to reach -80°C for the 10, 20, and 35L tanks were 7h54min, 8h41min, and 14h14min, respectively. The decrease in LN2 levels of the 10, 20, and 35L tanks for 7days without a drilled hole were 2cm, 4cm, and 4cm, respectively. The temperature remained at -196°C in all tanks without tank damage.

Conclusions

In this study, the speed of LN2 decrease of the 35L tank was slower than that of the 10 and 20L tanks when damaged. The larger the capacity of the tank, the longer it took for the temperature rise to begin and for the temperature to reach -80°C . There was a difference of 6h20min between the 10L and 35L tanks to reach -80°C . Therefore, it should be kept in mind that the rescue duration of embryos over the tank failure vary depending on each tank capacity.