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COMMENTARY

Temperature variations inside commercial IVF incubators

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Fine temperature regulation is critical to embryology laboratories aiming to maximize in vitro fertilization (IVF) and development, implantation and pregnancy of assisted reproductive technique (ART) embryos growing in culture under incubator conditions, although developmental plasticity of embryos permits them to develop over a range of temperatures [1].

Detailed knowledge of optimal temperature values for culture of gametes/embryos and incubator temperature control range is mandatory to preset correct biologically tolerable temperature limits. Embryology laboratories cover almost all IVF/ICSI-ET treatment needs with at least 2–3 incubators that should be checked daily for proper maintenance of temperature regulation. The absolute need for daily quality control of incubator temperature is justified by: a. the difficulty to maintain a stable temperature because of frequent opening the incubator door, b. overnight power failure, where incubators indicate the set temperature and the external thermometer indicates a drop of more than 1 °C with deleterious effect on embryo cleavage and development [2] c. The recent report in JARG recording tenths of degrees differences at different locations within the same incubator [3]. Although the digital temperature was set at 37 °C, temperatures differed significantly among top, middle and bottom shelves and between front and back shelve compartment, in line to the minor temperature variations observed by the report of Higdon and colleagues, underlying the possible role of the independent external measuring devices [4]

Prolonged exposure of cultures to temperatures other than optimal 37 °C, reduces the ability of fertilization (presence of two pronuclei) and nullifies the ability of cell division or cleavage, growth, implantation potential and subsequent achievement of pregnancy. For example drop of 1 °C from optimal temperature reduces the ability of embryos to cleave but allows division of nuclei (multiple nuclei in every blastomere) [2]. In other words, cytokinesis seems to be more temperature sensitive than mitosis. Furthermore, prolonged exposure of embryos to higher temperatures from optimal has deleterious effect on cytokinesis of all embryos either normally or abnormally fertilized (>2 pronuclei) [2, 5]. Therefore, embryos display extreme sensitivity to temperature stress. Moreover, in a top-load mini-incubator, after a 5-s opening of the incubator door, the time for temperature recovery was almost 5 min for the chamber and the dish. Temperature recovery of conventional front-load door incubator chamber after 5-s opening was about 20 min, while the dish took approximately 30 min to recover to 37 °C [6]. Consistent use of embryoscope is expected to reduce such unavoidable temperature changes considerably. Its integration in routine process yielded several advantages, such as better embryo selection according to kinetic parameters and observation of abnormal cleavage events, continuing education and training, quality control and flexibility. This lead to an overall increase in success rates in IVF cycles [7]. Nevertheless, no significant differences were found between the embryoscope (ES) and standard incubator (SI) from all the parameters evaluated, allowing only morphological, spatial and temporal analysis of embryo development [8].

The previous report in JARG underscores a new temperature problem of commercial IVF incubators. Inside the same incubator they detected temperature differences between the shelves (top, medium and bottom) and between the same shelf (front and back). According to their observations the front side of the shelf displayed no temperature difference relative to

Capsule Recent evidence reveals significant temperature differences between front and back sides within commercial IVF incubator shelves as potential cause of ART failure

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digital incubator temperature, in contrast to the back side of each shelf. Furthermore, the temperature in the top shelf was closer to digital incubator temperature and differed significantly from the temperature of the other shelves (medium and bottom). IVF incubator volume as a potential cause of this inconsistency is rather unlikely, provided manufacturer's warranty of uniform temperature in their products. Independent of the causes of temperature differences recorded inside the incubator, the complexity and sensitivity of IVF procedure requires extreme caution in order to maximize IVF outcome (quality assurance and quality control). One reason for the lack of impact on IVF outcome detected in this preliminary study may be the day of transfer used (day 2–3). If instead day 5 or 6 had been used for embryo transfer, IVF success might have been reduced considerably. In other words the prolonged exposure of developmental embryos to suboptimal temperatures may reduce the rate of blastocyst formation or the formation of the blastocyst itself. For that reason embryology staff should be aware of potential temperature hazards and work systematically to reduce them. Practical difficulties like work load may prompt embryology staff to perform embryo transfer at day 2 or 3 rather than day 5 or 6, and thus avoid cumbersome temperature monitoring of IVF incubators front, back, top, medium and bottom shelve compartments. In cases of established IVF embryology laboratory choices of embryo transfer at day 5 or 6, then meticulous temperature measurements in commercial IVF incubators should be done in order to avoid any potential deleterious effects. But again, the use of embryoscope can overcome the temperature variations described above, without excluding the possible existence of small temperature variation across the surface of small incubators.

The recent information on temperature differences inside various commercial IVF incubators will be useful for the study of the effect of various factors on human embryo culture, development and overall IVF outcome.

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