

Evaluating Viability of IVP Embryos

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In vitro produced (IVP) embryos produced by *in vitro* fertilization (IVF) often exhibit wide variations in developmental competence and viability, considerably more than are exhibited by embryos that develop *in vivo*. These anomalies in IVP embryos may be due to heterogeneity of oocyte quality, suboptimal culture conditions, disturbances in gene expression, or most likely a combination of these factors (Ho *et al.*, 1994; Roth *et al.*, 1994; McKiernan and Bavister, 1998; Hasler, 1998; Schramm and Bavister, 1999; Doherty *et al.*, 2000; Hyttel *et al.*, 2000; Niemann and Wrenzycki, 2000; Wrenzycki *et al.*, 2001). In research studies or in clinical applications with domesticated animals, cats, non-human primates and humans, oocytes used for IVF are usually collected from a heterogeneous cohort of ovarian follicles that include oocytes which normally might not be ovulated and/or are deficient in developmental competence. Moreover, although major improvements in culture media for oocyte maturation and embryo culture have been made in the last decade or so, IVF technology is still far from perfect (Bavister, 1995; Thompson and Peterson, 2000; Gardner *et al.*, 2000; Vanroose *et al.*, 2001). It is now clear that gene expression, including the critical transition from maternal to embryonic genome control, is subject to perturbations by culture media components, although the mechanism of this disturbance is not understood.

Thus, there are two principal concerns with respect to IVP technology. We need to further improve IVP procedures, especially culture media formulations, in order to raise the average quality of embryos; and also to improve methods for selecting the most viable embryos for transfer. For embryo selection, the dilemma is to evaluate embryos in ways that are rapid, simple, accurate and non-invasive. At present, the method that best fits all of these criteria is embryo development timing. While the timing of embryo development *in vivo* mostly proceeds according to a precise schedule in all species, IVP embryos commonly show heterogeneity in their development timing, concomitant with variability in developmental competence. Those embryos that develop in a timely manner have the highest developmental competence and viability post-transfer, as shown in studies with a variety of species, such as rodents, cattle, and

primates (McKiernan and Bavister, 1994; Hasler, 1998). Using timing of human embryo development during a limited time window, cleavage stage embryos were selected for transfer that supported pregnancy rates equal to those obtained with blastocyst transfers (Racowsky *et al.*, 2000). Research studies on the timing of embryo development and its relationship to embryo viability will be discussed.

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