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Magnetic Fields in Incubators a Risk Factor in IVF/ICSI Fertilization?

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ABSTRACT

Power frequency magnetic fields can reach tens of μT in incubators used for in vitro fertilization. This article suggests that this can be one factor connected to the observed increase of congenitial defects in children born after such procedure.

Key Words: Embryonic development; Congenitial defects.

An increased risk of congenital defects in children born after in vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI) has been suggested by the results of several controlled studies (Berg and Wennerholm, 2002; Hansen et al., 2002). The question they ask is whether the increased risk is caused by any of the drugs that are used or by the IVF/ICSI procedure itself. Here, we would like to highlight the possibility that the increased risk can be connected to the power frequency magnetic fields inside the incubators used in the in vitro process.

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We have worked on cellular tests and effects of weak magnetic fields for several years and, during this time, we have come into contact with many different types of incubators. Depending on the construction, the magnetic fields from the different electrical components vary in size. The field can be as high as hundreds of microtesla (μT) close to the fan engine, and values of around tens of (μT) are not unusual in places close to the electronic equipment (the control panel for temperature). The heat coil itself also contributes significantly to the fields inside the incubator.

Several research findings today indicate biological effects after exposure to similar weak magnetic fields, including both cellular tests and the influence on embryonic development in laboratory animals. In connection with the latest evaluation of the carcinogenicity of magnetic fields that was carried out by IARC during the 2001 (classification 2B: ''possibly carcinogenic,'' see further (IARC, 2002)), an overview was also made of the effects of magnetic fields on the reproduction (IARC, 2002) and several studies found effects at levels of around 1–10 μT, (i.e., the same levels as in the incubators). We have also studied cromosomal aberrations in amniotic cells after magnetic field exposure ourselves (Nordenson et al., 1992, 1994) and found a threefold increase after an exposure of 30 μT, 50 Hz. Studies of peripheral lymphocytes in train engine drivers exposed to high magnetic fields also show an increased proportion of cromosomal aberrations in this occupational group compared with controls (Nordensson et al., 2001).

In connection with the internationally coordinated multilaboratory study, ''The Hen House Project,'' it was found that early chicken embryos are sensitive to fields as low as single μT. Among the documented defects were incorrectly closed neural tubes (Berman et al., 1990). Several studies have also shown that exposure to 50/60 Hz magnetic fields at strengths of a few μT leads to an increased output of heat-shock proteins (hsp) after short-term exposure, but Di Carlo et al. (2002) have recently shown that a 4-day continuous exposure of chicken embryos led to a decrease in the hsp level, and thereby in the protection that an increase of hsp gives. These studies at least suggest that early vertebrate embryos are sensitive to weak magnetic fields.

Two studies on miscarriages and magnetic field exposure were published in California in January 2002. In a prospective cohort study, Li et al. (2002) found that for those who had been exposed to more than 1.6 μT and miscarried before week 10, the relative risk (RR) was 2.2 (95% confidential interval (CI) = 1.2–4.0), and for women with previous pregnancy problems the RR was as high as 5.7 (95% CI = 2.1–15.7). In a case-control study, Lee et al. (2002) found that women with a highest exposure of more than 3.5 μT had an odds ratio of 2.3 (95% CI = 1.2–4.4). Both of these studies are now being debated and follow-up studies are to be expected.

Against this background, we believe that potentially high magnetic fields in incubators could be one of the factors behind the increased risk of congenital defects in IVF/ICSI fertilization. What can be done to control this factor is to measure the magnetic fields inside the incubator, and if the levels are confirmed to be too high, the incubator should be remodeled to bring down these leakage fields to acceptable levels. Technically, this is often easily achieved. Moreover, the high leakage fields are usually centered around certain areas of the incubator (e.g., close to the fan, near the control panel), and the use of these areas of the incubator can then be avoided.

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