Chapter XXXIX
In Vitro Fertilization and the Embryonic Revolution

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ABSTRACT

The advent of in vitro fertilization (IVF) marked a watershed in the scientific understanding of the human embryo. This, in turn, led to a renaissance of human embryology, accompanied by the ability to manipulate the human embryo in the laboratory. This ability has resulted in yet further developments: refinements of IVF itself, preimplantation genetic diagnosis, the derivation and extraction of embryonic stem cells, and even various forms of cloning. There are immense social and scientific pressures to utilize the artificial reproductive technologies in ways that have little or no connection with overcoming infertility. As the original clinical goals of IVF have undergone transformation ethical concerns have escalated, so much so that they are condemned by some as illustrations of 'playing God', while any babies born via some of these procedures are labelled as 'designer babies'. Both terms reflect the fear and repugnance felt by some at the interference with the earliest stages of human life by the artificial reproductive technologies. It is at these points that bioethical analyses have an important contribution to make.

INTRODUCTION

Since its introduction in 1978 (Steptoe and Edwards, 1978), *in vitro* fertilization (IVF) has proved revolutionary. The most evident face of that revolution are the three million individuals born using IVF. This in turn has ushered in a plethora of related assisted reproductive technologies (ARTs) that represent a new genre of medical interventions in the reproductive process and even beyond. However, none of these revolutionary vistas could have eventuated were it not for a series of technological breakthroughs that lie, not in the clinic, but in the laboratory. These

breakthroughs revolve around the human embryo, which can now be maintained *in vitro* and therefore manipulated in a laboratory environment. The ability to isolate the embryo in this manner has opened up a new era for biomedical science, and in its wake a new era in bioethics. This is because the embryo has shifted from being an object of theoretical debate to occupy a central role in sociopolitical and ethical debate, a highly contested and deeply fraught realm.

The magnitude of this transition is difficult to exaggerate. Moral concerns about the status of the human embryo have been expressed for many years, chiefly by reference to induced abortion and the status of the much older fetus. While the ethical model provided by the abortion debate was seen for some time as providing an adequate model for analysing the preimplantation embryo, this is clearly not the case. The 3-4 month old fetus within a woman's body is far removed from the 3-6 day old embryo in a laboratory. The first is well on its way to becoming a new individual; the second has no such prospects until it is implanted in a woman's uterus. The first has many of the marks of individuality; the second has few if any such marks until implantation and further biological development take place. The first is beyond the reach of experimental manipulation; the second is generally the object of analysis and study, and potentially manipulation.

The world of the ARTs precipitates discussion of scientific, ethical, philosophical, theological, social and policy issues. Each of these has a part to play in ongoing debate on the ARTs, in that their interrelationship renders inadequate any one approach on its own. This is a challenge for those to whom such an interdisciplinary enterprise is foreign.

In this chapter we shall assess what this move from moral philosophy to public policy entails. In doing this we shall have to determine how the concerns of the public about 'playing God' and producing 'designer babies' can be balanced against the thrust of scientific advance and clinical expectations. The different worlds represented by the two are on a collision course, and the task of ethical analysis is to find ways of coping with this collision. However, the novelty of this task for bioethicists is itself a challenge.

EMBRYONIC DEVELOPMENT

Embryonic development begins when an egg is successfully fertilized by a single sperm, a process that takes between 26 and 30 hours to complete. The resultant single cell, the zygote, is totipotent, that is, it has the potential to give rise eventually to a complete new individual. On the second day of development, this single cell undergoes cleavage, during which it divides with little intervening growth to produce two, then four, then eight smaller, identical cells. These are the blastomeres, which at the eight-cell stage are only loosely associated with one another, each retaining its totipotency. By the 32-cell stage, they have become increasingly adherent and closely packed, and have almost definitely lost this equal developmental potential.

By day five the embryo consists of well over 100 cells and is termed a blastocyst. The outer cells of the blastocyst differentiate to form a surface layer, the trophectoderm, which becomes the trophoblast, which in turn eventually gives rise to the placenta. By contrast, the inner cells of the blastocyst constitute the inner cell mass (ICM) and are still undifferentiated (unspecialized), retaining the potential to form every type of tissue involved in the construction of the fetus (the cells are pluripotent). Some of these cells will later form the embryo proper and subsequently the fetus. Around day seven the blastocyst embeds in the uterine wall, marking the beginning of implantation, which is usually completed by day 14. Hence, the term preimplantation embryo refers to the embryo up to 14 days' gestation.

At 15 to 16 days the primitive streak, a transitory developmental structure, becomes evident in