The Question of Human Cloning

by John A. Robertson

The idea of splitting off cells from embryos to clone human beings sounds so bizarre and dangerous that one would think the practice should not be permitted. A closer look reveals its ethical acceptability.

Accustomed though we are to advances in medical technology, a 24 October 1993 news report that human embryos had been cloned astonished many persons. A *New York Times* story, "Researcher Clones Embryos of Humans in Fertility Effort," was the feature that Sunday morning in many newspapers throughout the country. Media coverage continued for several days, with debates about cloning on editorial pages, *Nightline,* and *Larry King Live.*

Within a week the issue had faded from media consciousness, aided in part by *Time* and *Newsweek* stories that stressed the huge gap between the reported research and the *Jurassic Park*-type fears of cloned human beings that initially spurred national coverage.[1] Bioethicists and lawmakers, however, must still contend with the ethical and policy issues that even limited cloning of humans presents. Should researchers be free to continue cloning research? May infertile couples and their physicians employ cloning to form families? Or should government prevent cloning research or discourage some or all of its later applications?

As with many biomedical developments, these questions present a mix of issues that need careful sorting. They involve, among others, questions of the propriety of embryo research, the validity of deliberately creating twins, and the importance of nature versus nurture in forming human beings. They also raise slippery slope concerns: should otherwise seemingly valid uses of a new technique be stopped to prevent later undesirable uses from occurring? To address those issues we must first describe the cloning research that has touched off the furor and the concerns that it presents.

Two Types of Cloning

The research that put cloning on the public agenda was a long way from Huxleyian fantasies of identical babies, mass produced in laboratories, and did not involve cloning as conventionally understood at all. To clone means to create a genetic copy or replica. Perhaps due to science fiction fantasies, it has been assumed that cloning would occur by removing the nucleus from the cell of one person, placing it in an egg that has had its nucleus removed, and then implanting it in a laboratory incubator or a woman who would bring to term a child with the identical genetic characteristics of the person providing the cell nucleus. Although this procedure has worked with frogs, it has never succeeded with mammals and appears highly unlikely to be accomplished in even the mid-range future. If this form of cloning were possible, scientists could fabricate as many copies as one wished of any available human genome, subject only to the limits of uterine or artificial gestation.

A second and more limited way to create clones is to split the cells or blastomeres of an early multicelled embryo before the cells have begun to differentiate. Because each blastomere at this stage is in theory totipotent (that is, capable of producing an entire organism itself), the separated cells can become new embryos, all of which will have the same genome. This form of cloning is now practiced to some extent in the cattle industry. Cloning by blastomere separation is limited to the number of cells that can be separated before cell differentiation, which destroys totipotency, occurs.

The study that generated the recent interest in cloning involved a small but essential step toward cloning human beings by embryo splitting. Researchers at George Washington University Hospital in Washington, D.C., separated cells or blastomeres from seventeen two- to eight-celled preembryos and showed that, to a limited extent, they would divide and grow in culture. The cells had been obtained from polyspermic embryos that had no chance of implanting in the uterus and that ordinarily would have been discarded. The separated blastomeres were coated with an artificial zona pellucida and placed in the culture medium used for in vitro fertilization (IVF).

The researchers obtained forty-eight blastomeres from the seventeen polyspermic embryos (eight two-cell, two three-cell, five four-cell, and two eight-cell), or theoretically forty-eight new totipotent embryos. A similar percentage of embryos cleaved for each stage of the embryo from which they were taken. While morulas (thirty-two-celled embryos) were achieved when blastomeres

John A. Robertson *is Thomas Watt Gregory Professor of Law at the University of Texas, Austin.*

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from two-celled embryos were cultured, blastomeres from four-celled embryos developed only to the sixteen-cell state, and no blastomeres derived from the eight-cell stage grew past eight cells in culture. These results suggest that splitting embryos at the two-cell stage appears to be more conducive to further development than does separation at the four-cell or eight-cell stage. However, the maximum stage at which a single blastomere can be reprogrammed to exhibit totipotency by itself or with cellular materials transplanted from other cells is unknown.[2]

The study thus demonstrated that experimental cloning or twinning of human embryos is potentially feasible as an aid to relieving infertility, though much additional work remains before offspring are produced, and there is uncertainty whether the technique will ever work at all. To produce a child by this method would first require showing that excised blastomeres from normal embryos would grow in culture to the point at which transfer to the uterus would ordinarily occur. Such research should also show the optimal stage for splitting normal embryos. It would then be necessary to place embryos that appear to be developing normally from split blastomeres into the uterus to show their potential for implantation and a successful pregnancy.

Some experts, however, are dubious that infertile couples would ever benefit from cloning by blastomere separation.[3] They view the higher pregnancy rate after transfer of several embryos as due to the genetic heterogeneity of the embryos transferred, not to numbers alone. On this view, placing several genetically identical embryos in the uterus will not increase the chances of pregnancy if one embryo with that genome would not have implanted. If this view is correct, there will be little incentive to use blastomere separation to treat infertility, and the ethical issues discussed below will have little practical significance. The following discussion, however, assumes that blastomere separation could provide certain advantages in treating infertility, and examines the ethical and policy issues that then arise.

Fears and Concerns

Some commentators saw nothing particularly unethical or disturbing in the George Washington research. This was simply another step toward improving the efficacy and efficiency of IVF, particularly for those couples who produce too few eggs or embryos to initiate pregnancy.

Many news reports, however, highlighted the disturbing or possibly unethical features of cloning and quoted ethicists who found the practice troubling. They described hypothetical scenarios in which embryos would be cloned for sale or to produce organs and tissue for existing children who needed transplants. One ethicist termed cloning as "contrary to human values"; others saw it as "an opportunity for mischief" that called for "governmental and societal debate and, perhaps, prohibitions and restraints."[4] The Vatican newspaper termed it a step into "a tunnel of madness," while the United Methodist Church called for an executive order banning cloning in all federally financed institutions.[5] A poll a week after the first story reported that 60 percent of Americans opposed cloning.[6]

The fears and concerns about cloning have several strands. Some of them arise from the artificial nature of assisted laboratory reproduction. Others are tied to discomfort with the manipulation and destruction of embryos that cloning research, if not the procedure itself, will inevitably cause. The most prevalent ethical concern, however, arises from the dangers that intentional creation of identical twins or multiples of one genome might pose to resulting offspring. The fear is that cloning will violate the inherent uniqueness and dignity of individuals, as well as create unrealistic parental expectations for their children. It also opens the door to identical embryos being created and sold because of their genetic desirability, as cattle embryos now are sold to increase animal yield and profitability. A worst-case scenario envisages the mass production of identical embryos to be sold to persons seeking desirable children. Finally, there are fears that embryos will be created to provide organs and tissue for existing children who need transplants.

Despite these reservations, research into the feasibility of splitting embryos will undoubtedly continue. Cloning by blastomere separation is basically a mechanical procedure that requires only the ability to micromanipulate fertilized eggs and embryos and a few hundred dollars' worth of culture medium.[7] No DNA analysis or genetic expertise is necessary. It is likely that the next research steps—separating and culturing single blastomeres from normal embryos and then placing those that grow well into the uterus—and the actual birth of children as a result of embryo splitting might well occur in the next two to five years. As micromanipulation of eggs and embryos is a rapidly growing practice, the ability to excise blastomeres from an embryo will easily be within the reach of many IVF physicians and embryologists. If shown to be safe and effective, physicians in many fertility centers will then offer the procedure to patients.

These possibilities engender a recurring disquietude about new reproductive technologies. Scientific zeal and the profit motive combine with the desire of infertile couples for biologic offspring to create an enormous power to manipulate the earliest stages of human life in infertility centers across the country. Even before one innovation is fully assimilated, the largely unregulated billion-dollar infertility industry presents another "improvement," which separately or together threatens disturbing consequences for offspring, families, and society.

Some persons would argue that the idea of creating exact replicas of other human beings is so novel that there should be a moratorium on further research and development until a national consultative body evaluates the ethical acceptability of the procedure and develops guidelines for research and use of the technique. At the very least, to prevent abuses there should be strict rules about the circumstances in which cloning by embryo splitting occurs, and about the uses made of cloned embryos.

A closer look at the issues, however, suggests that the most likely uses of

cloning are neither so harmful nor so novel that all research and development should now stop until the ethics of the practice are fully aired, or that governmental restrictions on cloning research or applications are needed. Indeed, there may be no particular need for guidelines beyond the full and accurate disclosure of risks and success rates that should always occur in assisted reproduction.

To assess the ethics of embryo splitting and the need for regulation, we must first ask who would use this technique if it were available and why, and then analyze the ethical issues that the likely demand for cloning would generate. We can then address the need for regulation of the embryo research that is essential if cloning by blastomere separation is to occur, and of the uses to which cloning techniques will be put.

The Demand for Cloning

The news accounts of the George Washington University research emphasized many speculative uses of cloning, thereby slighting the most likely uses of the technique. The immediate impetus to develop cloning—and its most likely future use—is to enable infertile couples going through IVF to have a child.

To Increase the Number of Embryos Transferred. Initially the main demand for embryo splitting would come from couples undergoing IVF who cannot produce enough viable embryos to initiate pregnancy. In basic IVF practice, the highest rates of pregnancy occur with transfer of three to four embryos. Often more than that number of eggs has to be fertilized to produce enough viable embryos for transfer, with the excess frozen for use during a later cycle. Couples who produce only one or two embryos may thus have undergone an expensive and, for the woman, onerous procedure that has little chance of success.

Cloning by blastomere separation appears to be a reasonable step for such couples, if genetic heterogeneity of transferred embryos turns out not to be a key determinant of pregnancy success rates. Their goal is the birth of at least one child. If the prospective parents produce only two embryos, they would face the difficult choice of transferring those two in the hopes that a single pregnancy would result, or increasing their chances of having one child by splitting the blastomeres of one or both embryos.

If they produce only one embryo and embryo splitting has been shown to be safe and effective, they may opt to divide that embryo. Depending on the embryonic stage at which splitting is most successful, this could produce two embryos (if split at the two-cell stage), four (if split at the four-cell stage), or even eight (if two embryos are both split at the four-cell stage).

The number of embryos they end up with will affect the number of embryos placed in the uterus at any one time, and also whether cloned embryos remain available for transfer on a later cycle. If their efforts yield only two embryos, it is likely that both will be transferred to the uterus. (If both implant and come to term, embryo splitting will have produced identical twins).

If they produce four or more viable embryos by blastomere separation, three or four might then be transferred to the uterus in the hopes of having one child, with the rest frozen for later use.[8] Assuming two cycles of transfer with two to four embryos transferred in a given cycle, several possibilities arise. No children could be born from transfer in either cycle, or one or two could be born from the first transfer, and none from the second, or vice versa. In any given case, no child, one child, or deliberately created twins would have been born as a result of blastomere separation.

However, this scenario also opens the door to having "twins" (or even "triplets" or "quadruplets") born several years apart. This would occur if one or two children were born as a result of the first transfer cycle. Three years later, perhaps, the couple wishes to have a second child, and rather than go through IVF again, opts to have the remaining cloned embryos thawed and transferred to the wife's uterus. The period between births of children with the same genome could vary from a year or two to several years.

Embryo Splitting to Avoid Subsequent Egg Retrieval. Other scenarios involving embryo splitting as a treatment for infertility can also be envisaged. Perhaps the next most likely scenario if cloning by blastomere separation is in fact effective would arise with a couple undergoing IVF who produce a sufficient complement of viable embryos to initiate a pregnancy—three or four—but who wish to avoid the expense and burdens of subsequent egg retrieval cycles. Not many IVF candidates are likely to find themselves in this position, since ovarian stimulation often produces ten or more eggs. Because the couple would need to split only one or two of the three or four viable embryos that they have produced, it is conceivable that many couples who produce only four embryos would opt for this procedure. Indeed, the demand for embryo splitting from this group might arise even if it turned out that successful implantation requires genetic heterogeneity of embryos and the procedure thus was not sought by the group that produces very few eggs.

If some of their embryos are split but only noncloned embryos are transferred during the first or subsequent cycles, couples may satisfy their need for offspring without having to resort to cloned embryos. However, if uncloned embryos do not produce (enough) children, some of the cloned embryos may be thawed and transferred during a later cycle. In that case deliberately created twins could result at the same time, or at a point separated in time from the first child born with that genome. A third or fourth cycle using cloned embryos could result, with genetic replicas of earlier children born separated in time.

In either scenario, cloned embryos that are no longer needed by the couple that produced them might be discarded or donated to other infertile couples. Twins or triplets of an existing child might then be born to and reared by another couple. Because embryo donation is ordinarily anonymous, neither the children nor the genetic or rearing parents are likely to know the identity of the others.

Embryo Splitting as a Form of Life or Health Insurance. An often cited though highly unlikely demand for embryo cloning could arise from

couples seeking insurance against disaster for any children that they have. That is, a couple might request that one or more blastomeres be split from embryos that will be transferred, so that the resulting clone can be frozen for later use in case the child born from the source embryo later dies or needs an organ or tissue transplant. In that case, embryos that are genetically identical to the child already born can be thawed and implanted in the mother (or a surrogate) to produce a genetically identical child to replace the dead child, or to serve as an organ or tissue donor for an existing child.

This scenario could occur, but it is unlikely for several reasons. First, few couples not otherwise undergoing IVF would choose to do so just to gain the hypothetical protection that identical backup embryos might provide. Second, couples that experience the death of a child may not, because of the sadness that it will engender, want to replace that child with a genetic twin, much less plan even before the first child is born to create a replica for that purpose. Third, couples undergoing IVF who produce enough embryos for transfer may not want to risk their viability by separating blastomeres for hypothetical insurance purposes. Fourth, a genetic replica of an existing child might not be necessary to provide needed organs or tissue, or there may not be sufficient time once organ failure in a child occurs to thaw, implant, and bring to term the cloned embryo to serve as an organ or tissue donor. Fifth, there may be medical reasons why a genetic twin will not be suitable as a donor, though in some cases, such as bone marrow or kidney transplantation, genetic homogeneity could provide an advantage.

Because so few couples—even those otherwise going through IVF—will request embryo splitting for this purpose, the use of cloned embryos as backup protection for existing children is likely to arise only with embryos that were created to enhance the efficiency of IVF. In situations of this kind, where the embryonic clones were *not* produced with the specific intention of insuring against disaster, parents might occasionally be glad of the opportunity to avail themselves of the stored cloned embryos to obtain tissue for transplant for an existing child, or to replace a child who has already died. Such scenarios are not impossible, but for the reasons stated above, they are not likely to be frequent.

Embryo Splitting to Obtain a Desirable Genome. Ethicists have speculated that cloning by embryo splitting might occur to facilitate, or might result in, the selection of stored embryos deemed to be particularly desirable. They envisage scenarios whereby parents will try to sell clones of desirable children to other couples, or where an attractive or successful couple will clone many embryos for later sale or dissemination.

These speculations are highly fanciful. Most couples are not in the market for other peoples' genetic offspring, but prefer to have their own. If so, they can exercise some control over the genetic characteristics of offspring by mate or gamete selection, or by preimplantation or prenatal genetic analysis. Few couples who can have their own children would be so obsessed with having a perfect child that they would eschew their own reproduction in order to obtain a cloned embryo that appears to have a desirable genome.

Of course, if cloning by embryo splitting is perfected, one could routinely excise and store a cell from every embryo that is produced and transferred to the uterus (assuming that this will not impair the embryo's development). The children born of the source embryo could then be followed, and the excised cells of those that turn out to have good genomes or healthy lives might then be sought by persons in quest of donor embryos. The mere description of the procedure shows how complicated and unwieldy it would be as a means to produce particularly desirable embryos.

However, couples who cannot produce genetic offspring might wish to have some say in the characteristics of embryos donated to them. In addition to choice of hair and eye color, and assurances that there are no genetic defects, they might want to see what the embryo they choose would look like as a child or youth, if such information were available. But there is no particular reason why it would be available, or why it would necessarily have to be provided.

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In any event, providing information about cloned embryos to prospective recipients would not itself lead to embryo splitting specifically for purposes of genetic selection. The couple undergoing IVF might clone to enhance IVF efficiency, but there would be no particular point in cloning embryos just to enable genetic selection of donor embryos to occur at some later time. If the sale of embryos is also prohibited, the financial incentives necessary to induce embryo splitting for later sale would not exist.

Ethical Issues: Destruction of Embryos

Cloning by blastomere separation raises a number of ethical issues. Some ethical concerns derive from the stark interference with natural reproduction, or the manipulation and destruction of embryos that cloning necessarily entails. However, those concerns are not unique to cloning, and have been voiced about embryo research, freezing, and discard, and about IVF generally. Since they are not deemed sufficient to justify banning or restricting those accepted

forms of assisted reproduction, they should not be sufficient to ban cloning either.

Yet persons who believe that fertilized eggs and embryos are already persons with rights will object that embryo splitting goes beyond the manipulations ordinarily involved in IVF. In this case a new unique individual will be intentionally split to serve other ends. The very process of blastomere separation could destroy embryos that would have developed normally, thus denigrating and undermining the value of human life. Because human life at all stages is a preeminent value, cloning by blastomere separation is an unethical procedure that should be banned.

There may be no way to answer the objections of persons who think that embryos are themselves persons and must be protected at all costs. The fact that embryo cloning might yield additional human lives will not assuage their concerns, for one is ordinarily not justified in killing one person in order to save several.[9] One can only point to the prevailing moral and legal consensus that views early embryos as too rudimentary in neurological development to have interests or rights.[10] On this view, splitting embryos can no more harm them than freezing or discarding them can. Nor is splitting embryos to enable one or more of them to implant and come to term inherently degrading or disrespectful of human life. Cloning embryos thus poses no greater harm to embryos than other IVF practices and should be permitted to the same extent that they are.

Ethical Issues: Deliberate Twinning

Ethical objections that are unique to cloning arise from a concern that the intentional creation of genetic replicas of an existing person denies the uniqueness of resulting offspring. This could occur from causing more than one child with the same genome to be born simultaneously. It could also occur from causing more than one child with the same genome to be born at different points in time.

Is the intentional creation of twins who are born simultaneously morally objectionable? Identical twinning occurs naturally and is not generally thought to be harmful or disadvantageous to twins. If anything, being a twin appears to create close emotional bonds that confer special advantages. If this is true, then having twins as a result of embryo splitting should be no more harmful to offspring than having twins naturally.

Suppose, however, that having twins does sometimes pose rearing problems or even psychological conflicts for children. For example, some families may have trouble rearing two infants simultaneously. Or asymmetrical relations with parents or intense rivalry between twins may occur, resulting in psychological harm to one or both of the pair. Still, the fact that undesirable outcomes might occur for some twins is no basis for concluding that all embryo splitting is unethical and should be discouraged.

The greatest chance that twins would result from embryo splitting would arise with a couple who produce too few embryos to have a reasonable chance of establishing even a single pregnancy. Their goal in embryo splitting is to have one child (or sometimes possibly two), but they know there is the risk that a twin pregnancy will result. If they knowingly accept the risks of twins, they will most likely be in a good position to handle the special burdens posed in rearing them. In any event, the risk of psychological harm from being a twin is neither so likely nor so severe that merely being born in this situation could constitute a harm. Twinning, whether natural or intentional, hardly amounts to a wrongful life. Neither child can reasonably claim that she has been wronged because, but for her parents' choice, she would have been born without a twin.

What, however, if triplets or even quadruplets are born simultaneously as a result of cloning by blastomere separation? If a four-cell embryo is split into four, and all separated blastomeres grow in culture and then are placed simultaneously in the uterus, the risk of a multifetal pregnancy increases. Multiple gestation does pose physical risks to the mother and to fetuses. Thus women who have multifetal pregnancies as a result of IVF or fertility drugs often use selective abortion to reduce the pregnancy to twins or triplets to improve the chances of a healthy outcome for all concerned. If multifetal pregnancies due to cloning occur, it is likely that they will also be selectively reduced to protect the health of mother and offspring.

Suppose a woman who is pregnant with triplets or quadruplets in virtue of transfer of four cloned embryos refuses to reduce the pregnancy to twins. Will she harm her offspring as a direct result of the cloning decision? Two different harms must be distinguished here. One is the potential harm of having three or four genetically identical siblings rather than just one, as occurs with twins. The second is the physical harm from prematurity that all offspring in such a multiple gestation might experience.

With regard to the first harm, it is not at all clear that identical triplets (or rarely, even quadruplets) suffer unique or inordinate psychological problems because they have identical siblings. If being an identical twin is generally a good thing, then it may be that being an identical triplet also has advantages and specialness that outweigh whatever disadvantages exist. At the very least, it would appear difficult to argue that these disadvantages are so great that the triplet should never have been born. Given that this is the only way for this individual to be born, its birth hardly appears to be a wrongful life that never should have occurred.

The risk of physical dangers of prematurity from a triple (or quadruple) pregnancy raises somewhat more complicated questions. Suppose the pregnancy ends prematurely at seven months. All three infants spend several weeks in intensive care and end up with permanent learning and physical disabilities. Have they been harmed by the cloning that produced a multifetal pregnancy, which their mother refused to reduce to twins? The child who would have been aborted would not appear to have been wronged by the mother's refusal because it had no other way of being born but in a triplet situation subject to the very risks that have eventuated.

But two of the three infants (there is no way to identify the two that would not have been aborted) are

worse off than they would have been if the pregnancy had been reduced to twins. Presumably they would then have been born healthy, without the physical and mental deficits they now have. One could reasonably argue that they have been hurt by their mother's refusal to reduce the pregnancy, even though there is no way to tell which two they are.

If the disabled offspring have been wronged, the wrong is not due to embryo splitting but rather to their mother's refusal to reduce the pregnancy from triplets to twins. The same arguable wrong would occur if the triple pregnancy occurred naturally or as a result of assisted reproductive techniques that did not involve cloning. Because the possibility of this wrong to the injured offspring is not unique to cloning, it is not an argument against all embryo splitting, any more than it is an argument against all use of fertility drugs or IVF, which also can produce multifetal pregnancies that are not reduced.

Ethical Issues: Later Born Twins

The second ethical issue unique to cloning by embryo splitting is the possibility of genetically identical siblings being born years apart in the same or different families. Are later born children harmed because a twin or triplet already exists? The claim rests on the notion that the later born child lacks the uniqueness or individuality that we deem essential to human worth and dignity, and that human individuality is largely determined by nature or genome rather than by nurture and environmental factors. Because phenotype and genotype do diverge, and because the environment in which the child will be raised will be different from that of his older twin, the child will still have a unique individuality. Physical characteristics alone do not define individuals, and there is no reason to think that personal identity will be wholly controlled by having an older twin.

Still, there could be special problems faced by such a child. Its path through life might be difficult if the later born child is seen merely as a replica of the first and is expected to develop and show the skills and traits of the first. This might be a special danger if the later born child is used as a replacement for an earlier born child who has died. However, it will be some years before the later born child is even aware of his genetic identity relative to an older sibling and the special expectations his parents might have.

But it is also as likely that the later born child will be loved and wanted for his own sake. His status as a later born twin (or triplet) could be seen as a special status, indeed, a unique or novel status that confers attention and love. It could also lead to close ties with the older twin, if the special bond that twins feel is genetically based. However, it could also lead to unique forms of sibling rivalry. Will the older twin feel that he is deficient because his parents wanted a newer version of him, or will he feel special and proud that his parents wanted another child like him? In any event, it is difficult to conclude that later or earlier born twins or triplets are likely to have such serious psychological problems that they should never be born at all. Even if one did so conclude, this would counsel against implanting cloned embryos only when a twin already exists, not against implanting two cloned embryos simultaneously or splitting embryos at all.

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Ethical Issues: Cloning as Life or Health Insurance

Although cloning for the explicit purpose of providing parents with a replica for a lost child or as a source of organs or tissue for transplant for an earlier born child will not frequently occur, couples who have split embryos to treat infertility might occasionally be faced with thawing a cloned embryo for those purposes. Consider, for example, parents who request cloning to protect against the loss or death of a child, or who wish to thaw a cloned embryo to replace a dead child. Wanting a child to replace one who has died is not itself unethical. Nor does it become so merely because the new child will be a twin of the first. Although the parents may hope that the new child will develop and show the same traits as her deceased twin, they should very rapidly learn that the second child is different in some respects and similar in others, and would ordinarily come to treat and accept her as the individual that she is.

The use of cloned embryos as insurance against organ and tissue failure in an existing child presents a different set of issues. Here the concern is that the cloned embryo will be treated as an instrument or means to serve the needs of an older twin and will not be loved or respected for his own sake. As the Ayala case in California showed, however, a family can be motivated to have another child to provide an existing child with bone marrow and still treat the subsequent child with the love and respect that children deserve.

If this is so, thawing cloned embryos to provide tissue or organs for an existing child should also be ethically acceptable. The key is whether the child will be loved and accepted by the family that brings her into the world, not how or why she was conceived, nor even whether she was cloned for that purpose. As long as the child's interests are protected after birth occurs, it is hard to see how being cloned or thawed to provide organs for a twin is any worse than being conceived for that purpose. Even if it were, the risk that some cloned embryos might be used to

provide tissue to existing children would not justify a ban on embryo splitting to treat infertility.

Ethical Issues: Embryo Splitting for Genetic Selection

Scenarios involving embryo splitting for genetic selection are, as discussed above, extremely unlikely as long as overall demand for embryo donation is low and the buying and selling of embryos is not permitted. Since it is highly unlikely that a market in embryos will develop, there will be little incentive for couples going through IVF to clone embryos in order to sell them in the future. This is true even if recipients of donated embryos are permitted to pay some of the costs of embryo production.

It is true that the small subset of infertile couples who are candidates for embryo donation might wish to know the actual characteristics of existing twins or triplets of the embryos they seek to "adopt." However, neither having nor satisfying this wish is itself immoral. Indeed, the right of adoptive parents to receive as full information as possible about the children whom they seek to adopt is increasingly recognized. There is no reason why the same principle should not apply to embryo "adoptions." Even though the couple seeking the embryos will be choosing them on the basis of expected characteristics, such a choice is neither invalid nor immoral. As long as the parents are realistic about what the information signifies, do not have unrealistic expectations about the child's perfection, and love the child for itself, seeking and providing such information prior to embryo donation should be ethically acceptable. If it were not, providing such information could be banned without requiring that embryo splitting to treat infertility also be banned.

Regulatory Issues

This account of cloning by embryo splitting and the ethical issues it poses suggests that, contrary to initial impressions, there is no major ethical barrier to proceeding with further research in embryo splitting as a treatment or adjunct to IVF. Given the great utility that embryo splitting could have for infertile couples, a moratorium on embryo splitting research is both unnecessary and unjustified. Such moratoria have occurred only when research appeared to pose great danger to others, as occurred with the brief moratorium on recombinant DNA research declared at Asilomar in 1975 because of the fear that genetically engineered pathogens might escape from the laboratory. By contrast, the risks of embryo splitting are no different from the risks that now exist in IVF laboratories and should be treated accordingly.

Even if a moratorium on cloning research is not justified, persons leery of embryo splitting argue for close regulation of the research that could perfect the practice, and then of its application. The most immediate policy questions concern whether there should be any restriction on research with embryos designed to improve or perfect techniques of embryo splitting. If research establishes the safety and efficacy of embryo splitting, then the question of regulatory limits on the use of the technique must be addressed.

The issue concerning the ethics of embryo research has several parts. One is whether research on normal embryos that will otherwise be discarded is ethically acceptable for any purpose. The second is whether embryos created by splitting blastomeres may ethically be placed in the uterus and brought to term. Such questions should be answered in terms of risks to the human subjects directly involved. As we have seen, the use of cloned embryos to treat infertility appears to be ethically acceptable. One should not deny investigators the right to carry out research otherwise respectful of human subjects because one disagrees with the utility or worth of eventual applications.

Research with Normal Embryos. The most immediate question is whether researchers should be permitted to split and culture blastomeres from normal embryos in order to replicate the results obtained at George Washington with polyspermic embryos. Although no authoritative American guidelines exist for research on normal embryos, there is a strong basis in the ethical literature and in practices of other countries for holding that such research is ethically acceptable.[11] Because early preimplantation embryos have no differentiated organs or nervous system, they cannot be harmed by splitting or other research manipulations and thus may ethically be used as the objects or vehicles of medical research.

As long as the research is for a valid scientific purpose, embryos that would otherwise be discarded can, with the informed consent of the couple whose gametes produced the embryos, ethically be used in research. Indeed, it should also be ethically acceptable to create embryos solely for research purposes when needed, even if there is no intent to place them in the uterus. Thus neither the lack of guidelines, the moral objections of some to any embryo research, or fears about where cloning research might lead justify forbidding researchers to take this next step. Researchers may not have the right to receive governmental or private funds for cloning, but if they are otherwise funded, their research should not be stopped because of objections to the use of embryos or to cloning itself.

Embryo Transfer after Splitting. Harder questions will arise if research shows that blastomeres separated from healthy embryos develop normally in culture to the point where they may implant in the uterus and go to term. Universities and IRBs might legitimately demand that implantation of manipulated embryos not occur until there are reasonable assurances that resulting offspring will not be physically harmed by the experiment. But if the embryos have developed normally in culture, this condition should be satisfied, just as it has been with embryos that were experimentally frozen and thawed before transfer, and with embryos that have been experimentally biopsied for preimplantation genetic analysis. When no physical harm appears likely, transfer to the uterus is ultimately beneficial for the resulting child (who has no other way to be born) and should be permitted. Again, neither the lack of clear guide-

lines, the fact that embryos will be manipulated and transferred, nor speculative fears of where blastomere separation ultimately could lead would be valid grounds for blocking this research.

Such a conclusion is consistent with the recommendations of commissions and advisory boards in the United States and abroad that have examined embryo research. Although they have not addressed cloning research directly, they do approve of transfer of embryos to the uterus after experimentation when the research is designed to aid or treat the resulting child. Transfer after experimental embryo splitting is designed to enable a child produced from blastomere separation to be born, and thus might be said to advance its interests. Just as the first embryo transfers after IVF were ethically acceptable because they enabled children to be born, so these should be as well, for there is no reason to think that if they implant and come to term they will have physical defects or otherwise be harmed.

Embryo Splitting Applications. Once it is shown that embryo splitting can produce normal offspring, the relative ease of the procedure and competition for patients will lead many IVF centers to offer it. Will it be necessary to restrict the uses to which embryo splitting is then put?

As the previous analysis suggests, the case for banning or greatly restricting embryo splitting as a treatment for infertility is extremely weak. The right of married and arguably even unmarried persons to procreate is a fundamental constitutional right that cannot be restricted unless clearly necessary to protect compelling state interests.[12] Because a ban on embryo splitting to treat infertility would directly interfere with the ability of infertile couples to have offspring, it would have to meet the compelling interest standard. Yet the prospect of great harm from intentional twinning, from twins born years apart, or from other possible uses of the technology does not appear to be so likely that governmental restrictions that go beyond assuring informed consent could be justified.

As with other forms of assisted reproduction, medical professionals who offer the service may be left largely to regulate themselves. IVF programs that engage in embryo splitting will have to decide at what stage embryos will be split, how many clones will be made, how many will be transferred at any one time, and how great a gap in time may occur between the birth of one child and another whose origin was the same embryo. They will have to develop procedures for counseling couples, particularly when twins are born months or years apart. Professional organizations, such as the American Fertility Society, might develop practice guidelines, as they have done with donor sperm and other reproductive technologies.[13] As long as the interests of couples and offspring are well served, there will be no need for governmental restrictions on the decisions made by medical professionals and their patients.

Nor do the more exotic scenarios imagined with cloned embryos necessarily warrant governmental intervention. The use of cloned embryos to replace a lost child or to provide tissue or organs for an existing child should be decided on the merits and ethics of those practices independently of creating or using cloned embryos for those purposes. If families may otherwise have children to serve as tissue donors for existing children, there is no basis for banning the use of cloned embryos for that purpose. Such uses are likely to be rare, and in any event, should not stop the use of cloning to treat infertility.

Similarly, couples seeking embryo donations should be entitled to as much information about the genetic characteristics of prospective offspring as is available. Wanting healthy, talented, attractive children is not per se immoral and should not in itself bar the use of the technique. Of course if it did, that would not bar other uses of cloned embryos.

Laws that restricted trade or commerce in cloned embryos would be an acceptable public policy. Although it is highly unlikely that demand for cloned embryos would lead to a market in them, it may be desirable to symbolize the unique value of incipient human life by banning the sale of embryos, whether cloned or not. Such a ban would not prevent infertile couples from getting access to infertility treatments or otherwise forming families, and thus would not limit or interfere with their procreative liberty. The ban need not prevent persons receiving embryo donations from sharing in some of the costs of embryo production.

If families may otherwise have children to serve as tissue donors for existing children, there is no basis for banning the use of cloned embryos for that purpose.

The Permissibility of Cloning

The idea of cloning human beings initially sounds so bizarre and dangerous that one would think that such practices should be closely regulated, if permitted at all. Yet this survey of ethical and policy issues in cloning by embryo splitting suggests that the procedure has fewer risks and more benefits than first appeared and would be ethically permissible in most cases. The most unappealing applications of the technique are highly speculative and could be restricted without also stopping more valid uses.

Cloning by embryo splitting thus presents a regulatory situation that often arises with new reproductive technologies. An immediate step that seems justified to meet the legitimate needs of infertile couples could open the door to future applications that are much less defensible. If we ban the immediate steps in order to prevent potentially harmful future appli-

cations, infertile couples lose the benefits of the procedure without a clear showing that future harms would necessarily have occurred.

The temptation in such situations is to defer further research and development until a national commission or ethics advisory body puts its imprimatur on the practice. While such bodies, however, have been absent from bioethical debate in the United States for some time, there now appears to be an increased willingness to confront such issues. For example, an advisory panel on embryo research has been created to recommend guidelines for federal funding.[14] However, it remains uncertain when any such body will consider the complicated issues of human cloning.

As a result, we are left to elucidate and resolve on a retail basis the ethical dilemmas that each new innovation presents. Cloning by embryo splitting is another example of this policymaking process. Unless there are greater risks from its use than are now apparent, the case for adding the technique to the armamentarium of infertility treatments is a reasonable one. Its novelty will not prevent parents from loving and acting in the best interests of children born in this way.

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7. Statement of Dr. Robert Stillman on *Larry King Live,* 25 October 1993.

8. However, it is possible that three or even all four embryos transferred will implant. In that case, the couple will face the issue of selective reduction of the pregnancy to twins. Depending on the number of children who are born, cloning by separation could lead to twins or even triplets as a result of intentional cloning.

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Blastomere Separation

Some Concerns

by Richard A. McCormick, S.J.

If one has no ethical misgivings about cloning by blastomere separation, then John A. Robertson's essay should be a corrective. It is breathtaking in the speed with which it subordinates every consideration to its usefulness in overcoming infertility. His thesis can be summarized as follows: if it aids otherwise infertile couples to have children, it is ethically acceptable.

In his words: "There is no major ethical barrier to researchers proceeding with further research in embryo splitting as a treatment or adjunct to IVF. Given the great utility that embryo splitting could have for infertile couples, a moratorium on embryo splitting research is both unnecessary and unjustified." These two sentences are different. The first is an ethical conclusion. The second leans much more toward policy. Robertson is concerned with both, as his title indicates. However, the second sentence (as well as his entire paper) reveals the shape of his moral reasoning: *anything* that is useful for overcoming infertility is ethically acceptable. Robertson might disown that conclusion but I find nothing in his paper to support such a disclaimer. Needless to say, I think a great deal more needs to be said. I shall gather this "more" under three titles: life, wholeness, individuality.

Life. What we may do to preembryos (embryos whose cells have

Richard A. McCormick, S.J., *is the John A. O'Brien Professor of Christian Ethics at the University of Notre Dame, Notre Dame, Indiana.*

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