



Cryopreservation of Embryos and Fetuses as a Future Option for Family Planning Purposes

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Abstract

This paper explores the ethical implications of a possible future technology, namely cryonics (i.e. the preservation of an entire organism at ultra-low temperatures for eventual revival) of embryos/fetuses extracted from the uterus. We argue that more research should be conducted in order to explore the feasibility of such technology. We highlight the advantages that this option would offer, including the foreseeable prevention of a considerable number of abortions.

Introduction

Abortion is one of the oldest and most debated issues in medical ethics. The discussion around the moral and legal permissibility of abortion has been going on for several decades, and the two general approaches to the issue are the so-called “pro-life” view and “pro-choice” view.

This paper does not have the goal of solving the moral problem of abortion by introducing a third moral approach to the issue or by presenting the best argument to support one view rather than the other. The goal is, instead, exploration of the use of a particular new technological means, namely cryonics (the preservation of an entire organism at ultra-low temperatures for eventual revival) in order to offer a new option that, among several other advantages, could prevent a considerable number of abortions.

At the moment, when a woman gets pregnant, the only options available to her are to continue the pregnancy or to terminate the pregnancy. However, it is possible that cryonics will offer the option of cryopreserving an embryo or a fetus some time after its implantation *in utero*.

This new practical option would, in turn, allow prospective parents to avoid the unwanted implications of both an abortion and an unplanned pregnancy.

Cryonics today

1) Cryopreservation of embryos

In one sense, we are already using cryonics for family planning purposes: cryopreservation of embryos is often used in addition to *in vitro* fertilization (IVF) in order to save the extra embryos created *in vitro* for possible later implantation *in utero*.

Embryo cryopreservation is the process of preserving an embryo (at a pre-implantation stage, i.e. from day 2 to day 6 of development) in liquid nitrogen at minus 196 °C. Both vitrification and slow programmable freezing techniques are used to cryopreserve the embryo and to avoid ice crystal formation. According to the International Committee for the Monitoring of Assisted Reproductive Technology, at the moment hundreds of thousands of embryos are cryopreserved in fertility clinics all over the world and, from 2007 to 2013, 2.5 million babies were born through IVF techniques.¹

IVF and embryo cryopreservation are relatively widespread and common techniques, and in some countries (such as the UK and Australia) their costs are (at least in part) subsidized by the public health system.

In principle, there is no reason to assume that cryopreservation would not work on embryos at the blastocyst stage or on a fetus (Pavone et al., 2011). Current embryo cryopreservation does not venture beyond the blastocyst stage, since it relies on natural implantation in the endometrium. If placental tissue could be cultured (for example by adopting methods from regenerative medicine), then fetal implantation outside the womb might become possible.

2) Cryopreservation of adult humans

Cryopreservation of adult humans can be defined as “the stabilization of critically ill patients at ultra-low temperatures to allow resuscitation in the future.”² The goal of cryonics is ultimately to prevent death by preserving the cell structure and chemistry of an organism (in this case a human being) so that, when technologies are sufficiently advanced, it will be possible to recover its body, memories and personality. Therefore, cryopreservation challenges current definitions of death (Hughes 2001).

In order to have the best chances to work (i.e. to be able to resuscitate the patient in the future), cryonics procedures should start soon after the heart stops beating so as to prevent deterioration. The individual is put in a bath of ice-cold water, so as to reach the body temperature of 10 °C. A mechanical device, the Heart-Lung Resuscitator, is used to restore blood circulation and breathing. Only the cardiopulmonary activity is restored, and cardiac activity is not restarted. Blood is replaced with an organ preservation solution that is especially designed to support life at low temperatures. This solution is not different from the one used for organs transported from the location of a donor to the location of a recipient. After these interventions, the body is cooled to a temperature close to minus 124 °C, and at the end of this two-weeks' process the body temperature is reduced to minus 196 °C. The cryopreserved bodies are stored under liquid nitrogen at this temperature.

According to the Alcor Life Extension Foundation, more than one hundred people in the world have been cryopreserved since 1967 and about one thousand people have made legal and financial arrangements to be cryopreserved (Alcor 2015). There has not yet been any attempt to resuscitate cryopreserved adult human beings, but given the fast progress of technologies in this field it does not seem implausible to think that at some point it will actually be possible to “bring back to life” human beings who are currently cryopreserved.

Cryonics currently has a slightly unusual epistemic status that makes it ethically controversial. Unlike embryo cryopreservation, it is unknown whether cryonics will ever work, although it is possible to perform suspensions today and store bodies for decades without change. Cryopreservation can hence be viewed as an experimental treatment where the outcome is in an indefinite future. For the purposes of this paper, however, we will simply assume that at some point fetal cryopreservation and resuscitation will be demonstrated.

Problems with embryo and fetus cryonic preservation

Quite obviously, the extraction and cryopreservation of embryos and fetuses developing *in utero* would pose some technical difficulties that differ from the ones posed by the cryopreservation of *in vitro* produced embryos and adult individuals. In particular: 1) it could be difficult to remove the embryo/fetus³ from the uterus without permanently damaging either the embryo/fetus or the uterus; 2) the procedure might be invasive of the woman's body if it turned out to be similar to a caesarean section. However, more sophisticated techniques might become available to make the removal safe, less invasive, and pain free for both the embryo/fetus and the woman. For instance, the technique used could be the reverse of the embryo transfer procedure that is currently used to transfer IVF embryos to the uterus.

Another option could be to cause the expulsion of the embryo/fetus using current induction of labor procedures. Techniques to resuscitate pre-term newborns are improving very rapidly, so that at this point most international guidelines advise resuscitation of newborn children born at the 24th (or even, in some cases, at the 23rd) week of gestation (Pignotti and Donzelli 2008), something that was inconceivable less than thirty years ago. If these techniques keep improving so that, for instance, an 8-week entity (i.e. the stage at which an “embryo” is commonly considered to become a “fetus”) will be viable, we will be able to keep alive newborns born after only two months of gestation, that is when the majority of terminations of pregnancies are performed. If cryopreservation of embryos/fetuses were technically feasible, we could induce the expulsion of the 8-weeks embryo/fetus, keep it alive to stabilize its vital parameters, and then proceed with

the cryopreservation. The first part of the procedure would be very similar to the one currently used to induce labor. However, in this case, the embryo would then be cryopreserved using a technique similar to the one we currently use to cryopreserve embryos for IVF or the one used for cryonics on human beings, depending on the developmental stage of the embryo/fetus at the moment it is removed from the womb.

Cryopreservation and the arguments against abortion

We will briefly introduce three arguments against abortion and we will show that they would not apply to the cryopreservation of embryos and fetuses.

a) Abortion is the killing of an innocent human being/person, and killing a human being/person is prima facie morally wrong

There is a long-term dispute on the question whether the embryo and/or the fetus, and even the newborn, are persons (Giubilini and Minerva 2013). One view is that the killing of an embryo/fetus is permissible whereas the killing of a person is not – the assumption being that an embryo/fetus is not a person in a morally relevant sense.

This distinction between a mere human being and a person is not the only relevant one in the debate about abortion. For instance, the Roman Catholic Church holds the view that, although an embryo or fetus is a potential person, and not an actual one, embryos and fetuses should be treated *as if* they were persons, meaning that the killing of an innocent human being (and potential person) such as the embryo/fetus is not permissible (unless the life of the pregnant woman is at risk) (Congregation for the Doctrine of the Faith 1987).

However, these issues are not relevant when we consider the option of cryonics as an alternative to abortion, because cryopreservation of an embryo/fetus would be neither the killing of a human being nor the killing of a (potential) person. Simply, it would not be a killing at all.

Indeed, cryonics challenges some definitions of death: a suspended organism is clearly not alive in a metabolic sense, yet this state may be reversible (Hughes, 2001). This might be true even for a patient *currently* too ill or damaged to survive, since future interventions might make their condition treatable. A full discussion of the status of a cryopreserved being is beyond the scope of this paper: for our purposes, however, it is enough to assume that cryopreserved fetuses are not dead, just suspended.

When the technical means to re-implant the embryo/fetus after the cryopreservation period are available, it will be clear that the cryopreserved embryo/fetus is not killed, just suspended. Of course, this is not yet the case, and it is possible that in the course of experiments to develop this technique some embryos and fetuses will indeed be killed. However, if the experiments are conducted on embryos and fetuses that would have been aborted in any event, it seems that no greater loss of embryos/fetuses will happen.

b) Abortion is immoral because an embryo/fetus is a potential person

According to the argument from potentiality, even if embryos/fetuses are not persons (meaning that they are not self-conscious and self-aware), they have the potential to become persons – someone like you and me – if nothing interferes with

their development (Giubilini 2012). Cryopreservation of embryos/fetuses would not represent a problem in this respect, as the potential to develop into a complete human being/person would not be stopped (as happens with abortions) (Ettinger 1964, 98).

Admittedly, there would be a delay in the process that brings the fetus to the state of a fully developed person, but this would not affect the potentiality of the embryo, in the sense that it would still go through a process that allows it to become a person. In this respect, cryopreservation could be similar to a hypothetical pill that would slow down the development of the embryo so that it would take it, for instance, 10 years (instead of about 9 months) to develop into a fully formed baby.

It seems to us that pro-life supporters would have no reason to object the use of such a pill, at least not on the basis that it would interfere with the potential of the embryo/fetus. For the same reason, they would have no argument (based on potentiality) against the use of cryopreservation as a replacement for abortion.

c) Abortion is immoral because an embryo/fetus would suffer the loss of the value of its future

Don Marquis, in his well known paper “Why abortion is immoral,” proposes an argument against abortion that is based on neither the intrinsic value of every human being nor on the potentiality of the embryo/fetus, but on the value of its future (Marquis 1989).

Marquis argues that, regardless of whether or not the embryo/fetus is a potential person, its future has a value, although its future is not foreseeable to it, just as the remote future is not foreseeable to us (actual persons). Indeed, irrespective of the plans for the future one might have, there is some value attached to having a future, even if one cannot make plans for such a distant time in life. In this sense, embryos/fetuses and actual persons share the same interest in not being killed.

Again, cryopreservation of embryos and fetuses would be a good alternative to abortion for people who share this view, because cryopreservation would not prevent the embryo/fetus from having a future.

One could argue against our proposal that, although cryonics does not damage the value of the future of the fetus, nor its potential, it would still postpone the moment the fetus would be fully developed and therefore able to appreciate the value of its own future or to further develop its potential. This objection could be called “the natural law objection” and it would have to be based on the natural right of an embryo/fetus to be born about nine months from conception. However, it seems there is nothing particularly valuable about being born nine months after conception. Moreover, this argument should be applied also to the embryos that are currently cryopreserved and that, according to this argument, would have had some sort of natural right to be implanted upon conception even if the circumstances were not ideal for their development: for example, because implanting more than one embryo could result in multiple pregnancies or because the woman’s health condition was not momentarily compatible with pregnancy.

To sum up, since cryopreservation of embryos and fetuses does not imply their killing, any objection based on the fact that the embryo or fetus is deprived of its life and/or future can be straightforwardly rebutted.

Advantages of fetal cryonics over other family planning options

Reproduction in the last decades has increasingly changed from a matter of chance to a matter of choice. However, if a woman gets unwillingly pregnant, she has to make the decision whether to have an abortion, to give up for adoption the child after it is born, or to change her life projects and embrace motherhood at a moment of her life when she might not feel ready for that. There is no technological means that allows pregnant women to postpone the moment they become mothers by giving them the opportunity to have the very same child they are currently pregnant with and to avoid an abortion.

Cryopreservation of embryos and fetuses could be a valuable option at least in the following cases:

1) Cryonics and abortion

Cryopreservation of embryos and fetuses would spare women/couples the distress of an abortion. This distress can be significant if they think that abortion is not a moral option but they nonetheless feel forced by the circumstances to make a decision to terminate the pregnancy.

At least in some cases, people who have an abortion are not in principle against the idea of becoming parents, but they are not ready to take up that responsibility at that precise moment of their life (Finer et al. 2005). It might be that in a few months, or in a few years, their economic, social, family or emotional situation would be different and they would try to get pregnant on purpose. However, women's fertility tends to decrease over the years, so it might be that the same woman who chose to have a termination of pregnancy when she was 25 would need to use IVF ten or twenty years later. If it were possible to cryopreserve the embryo/fetus in her womb when she was only 25, then she could implant it twenty years later when she felt ready to become a mother, hence avoiding both abortion and IVF.

2) Cryonics and adoption

Some women are reported to experience extreme distress after giving their child up for adoption (Condon 1986). Likewise, children who have been given up for adoption, and have had to go through various foster families and institutions, are reported to suffer from psychological distress (Simmel 2007; Hoksbergen et al. 2003). If cryopreservation of embryos and fetuses were an option, parents could be spared the stress of giving their child for adoption, and they could keep the fetus cryopreserved until circumstances had changed and they could raise a child. If adoption were their preferred option, they could avoid continuing the pregnancy until the end of the gestation (something that some women find burdensome) and could assign the fetus for adoption at an early stage. It could then be implanted in the uterus of the adoptive or surrogate mother.

The latter solution could be preferable to the current adoption system where children given up for adoption are often mature enough to suffer from the trauma of going through several foster care families before being allocated to their permanent adoptive family.

3) Cryonics and birth of a disabled child

Cryopreservation of embryos/fetuses could also be a good option for prospective parent/s who would otherwise choose an abortion because the embryo/fetus is affected by abnormalities. At the moment, if these conditions cannot be treated before birth or after birth, the fetus will a) be voluntarily aborted by the woman; or b) die because of a natural miscarriage due to the disease it is affected by; or c) be born, and have to live with, a disability (Verhagen and Janvier 2013). However, if cryopreservation were available, prospective parent/s could choose to cryopreserve their child in the hope that a therapy would be developed. It might be that such therapy would not be developed while the parents were still alive and/or willing to re-implant the embryo/fetus, so the embryo/fetus might eventually be discarded. But if there were a reasonable prospect of a therapy being developed in time for the embryo/fetus to be re-implanted, cryopreservation would appear a good option to offer prospective parents. In this respect, cryonics could be considered a life-saving treatment, especially for those embryos and fetuses affected by abnormalities incompatible with life.

It is well beyond the purposes of this paper to discuss whether abortion of a disabled fetus is a morally permissible choice because perhaps some disabilities make life not worth living for the individual who is affected; or whether abortion is a morally justifiable decision because taking care of a disabled individual is a choice that should be left to the people who are going to take care of this child, namely the parent/s.

In any case, regardless of the reasons one might use to justify the abortion of a disabled fetus, it seems that cryopreservation would be a good option to offer: parents could choose to cryopreserve the prospective child until a therapy for its disability could be found. Alternatively, cryopreservation would give the parents more time to prepare themselves for a life with a disabled child. For instance, they could choose to re-implant the fetus once they had learned more about the needs of a child with such a disability, or when they felt psychologically and/or economically ready to raise a child with special needs.

4) Cryonics and IVF

The Roman Catholic Church opposes IVF techniques because they imply (just as contraceptives do) a separation between the two fundamental elements of human sexuality, namely the unitive and the procreative elements (Congregation for the Doctrine of the Faith 1987). Whereas contraception has the goal of allowing intercourse while avoiding unwanted pregnancies, IVF techniques do not require intercourse between two people and procreation as the only aim. However, if the embryo/fetus were removed after the woman became pregnant during sexual intercourse, and then the embryo/fetus were removed from the womb to be cryopreserved, there would be no separation of the unitive and procreative moments.

Cryopreservation of embryos and fetuses could be used as an alternative to IVF for couples who do not want to separate the unitive and procreative moments, but who, for whatever reason, might not be able to conceive in the future. Moreover, unlike IVF techniques which require male masturbation (considered a sin by the Roman Catholic Church) to collect sperm cells, cryopreservation would not necessitate masturbation. Fertilization would occur through ordinary sexual intercourse.

5) *Cryonics and ectogenesis*

Peter Singer and Deane Wells, in their book *The Reproduction Revolution*, suggested that ectogenesis could solve the problem of abortion by allowing women to put the fetus in an artificial womb. Singer and Wells thought that both pro-life groups and feminists should have welcomed the development of ectogenesis techniques. Indeed, pro-life groups should have welcomed the possibility of saving embryos and fetuses that would otherwise have died because of miscarriages and voluntary termination of pregnancies (Singer and Wells 1984, 135).

Feminists, on the other hand, should have supported the use of this (future) technology because ectogenesis would have allowed women to have control over their body yet still have the option of not having to kill the fetus. Singer and Wells acknowledged that it could have been argued that women have the right to decide whether their embryo/fetus should live or die because they might not like the idea of the embryo being handed to another woman or couple. However, they argued, the right to kill a healthy fetus would need to be proved against the right to life of the fetus itself, and this would be a different matter.

Leslie Cannold interviewed both pro-life and pro-choice women and asked them various questions about what they thought of, among other issues, abortion, adoption and ectogenesis (Cannold 1998, 115). Cannold found out that both pro-choice and anti-choice women thought that ectogenesis was not a moral option. Both groups of women were worried about the possibility that their fetus would not develop normally in an artificial womb; they did not trust science enough to put their fetus in a machine; and they feared that a child born this way would lack a stable sense of self.

For instance, according to a pro-choice woman interviewed by Cannold, ectogenesis was not a moral choice “because instead of giving away one’s fetus and child to another woman, a pregnant woman was relinquishing her fetus to a machine.” Moreover, as in the case of adoption, the woman was not taking responsibility for the child she conceived. Pro-choice women interviewed by Cannold agreed that if a woman could not be responsible for her child, then the best option was not to bring a child into existence. Therefore ectogenesis and adoption were not considered the best options.

The pro-life women interviewed by Cannold agreed with the pro-choice ones that ectogenesis seemed not to be a good alternative to abortion. For instance, one said that, by relinquishing the child to the artificial womb, women would have felt like they had not done something wrong, whereas instead they had done something wrong by refusing to become mothers. Indeed, according to these pro-life women, the problem with abortion is not just the fact that a fetus is killed, but also the fact that a woman does not take her maternal duties seriously enough.

It seems that, for both pro-choice and pro-life women, choices about abortion do not pose only a question about the moral permissibility of killing a fetus, but also a question about how a woman interprets her duty to be responsible for the individual she has conceived. The main difference is that pro-choice women think that this responsibility is borne by not bringing such child into existence, whereas pro-life women think that becoming mothers, regardless of possibly adverse circumstances, is what constitutes a responsible behaviour. Given these considerations, it seems that cryopreservation of embryos/fetuses is a better option than ectogenesis:

1) The fetus would normally develop in the uterus, and not in an artificial womb as would happen with ectogenesis. Once the woman decided to recommence the pregnancy, the embryo would be implanted in her (or in a surrogated mother's) womb and then it would develop there just as happens with natural pregnancies.

Some women may be concerned about what happens to their embryos/fetuses during the time they are cryopreserved, but concerns about the trustworthiness of science apply to both the current practice of storing embryos and the future technique of cryopreserving embryos/fetuses. Some people do not trust science and scientists, but others do and at least these would not be particularly worried about what happens to their fetuses while they are cryopreserved.

2) The main reason why women interviewed by Cannold opposed ectogenesis was the idea that a woman (or a couple) would not be responsible for the product of her conception if allowed to relinquish it to the artificial womb. To pro-choice women, this lack of responsibility would consist in letting the fetus develop into a complete human being without its genetic mother or parents being there to look after it. According to pro-life women, by contrast, relinquishing the fetus to an artificial womb would be a way to show one's lack of acceptance of motherhood, and therefore display irresponsibility toward the fetus, just as with abortion.

The advantage of cryonics over both ectogenesis and giving up the fetus for adoption is that the woman could simply postpone the pregnancy and therefore (eventually) take full responsibility for her conceiving the child. This would be true irrespective of which notion of responsibility one held.

So, unless the women interviewed by Cannold meant that someone must take responsibility for the embryo/fetus they conceived within nine months of conception, it seems to us that the cryopreservation of embryos/fetuses should be welcomed by both pro-choice and pro-life women. It would satisfy the responsibility requirement, and it would also bypass concerns about the development of a fetus inside an artificial womb.

Obviously, the fact that an option is available does not imply that someone should be forced to use it. Indeed, we are not suggesting that women should be prohibited from having an abortion if the cryopreservation of embryos/fetuses were technically possible. We are instead arguing that this option should be investigated, given its potential benefits to some people over the options currently available.

Possible objections

In the following paragraphs we take into account some possible objections to the arguments developed in this paper. Since the topic is entirely new, we cannot foresee all the possible objections. However, the following are among the most plausible.

1) Women would choose not to re-implant the embryos after some years

The problem of leftover embryos is already widely discussed with respect to embryos created for IVF that are not implanted *in utero*. At the moment, the embryos are: stored indefinitely; used for scientific experimentation; destroyed; or "adopted" by other couples who then implant them in a woman other than the one who is the genetic mother.

If the biological parents were not interested in implanting the embryo/fetus within a given time from the cryopreservation (say ten years), then the fetus/embryo could be given up for adoption and implanted in another woman's uterus. However, in cases where this were not an option, the embryo/fetus could be discarded. In this case, the result would be (morally) identical to abortion, and cryonics would end up being not an alternative to abortion but a postponement of abortion. It might not be better than abortion, but at least it would not be significantly worse, and considering the possibility that these embryos/fetuses would end up being reimplanted *in utero*, it looks like cryonics would be still the best choice.

2) If cryonics were an option, people, and especially women, would feel the social pressure not to have an abortion, and this would constitute a limitation to their autonomy

Some women want to have an abortion because they do not want to be the genetic parent (or, better, the genetic ascendant) of (1) any individual in general or (2) a particular one.

The first case could be one of a woman who has chosen not to have children. In this case, it seems that the termination of the unwanted pregnancy would still be a better option than the cryopreservation of embryos/fetuses. However, it could be that a woman would prefer to cryopreserve the embryo/fetus and to give it up for adoption instead of killing it. In this case, cryonics would still be a genuine alternative to abortion. A key difference from abortion is that storage is reversible until implantation, adoption, or abortion: this provides time to reconsider, and no loss of options.

The second case would be one of a woman who got pregnant after being sexually abused, or of a woman who got pregnant with a man she did not want to have a relationship with. If this woman were not against having an abortion, she should probably choose the termination of the pregnancy of that particular embryo/fetus. Under these circumstances, however, women who have moral concerns about abortion might prefer to have the embryo/fetus removed from their body, cryopreserved, and given up for adoption.

It might be argued that, in the circumstances we have described, women, or couples, would feel social pressure to have their embryo/fetus cryopreserved instead of aborted because the option would be now available. This is certainly a possible (undesirable) outcome.

However it is also true that almost all the new possibilities that have been opened up by the development of new technologies have raised such concerns. For instance, it has been argued that women and couples could feel more pressure to use IVF techniques in order to have children since these techniques are now available and relatively safe and cheap (Rowland, 1987). And it may be that there is such a pressure to reproduce, just because it is now technically feasible. This sort of pressure seems to be a problem inherent to any new option that technologies make available to us. From cryonics to human enhancement, from embryo selection to genetic engineering, we have and will have more options and, almost inevitably, making decisions will become increasingly difficult.

But we need to weigh cons and pros of the implications of new technologies and assess whether we prefer to live in a world where we can make love without getting pregnant, have children when we are infertile, save the lives of a newborn at 24 weeks of gestation, and have our organs replaced when they fail, or whether

we would prefer not to have these options. We think that having more options is something that generally empowers people, even though in some cases social pressure can be a factor that reduces some individuals' autonomy.

3) Cryonics is science fiction

Cryonics of adult people is currently on the fringes of medicine, since it is not a proven treatment, and it will remain so until a convincing resuscitation. This may take a long time, but supporters find the practice rational since cryopreserved people have all the time in the world (or almost, given the small but cumulative risk from disruptions of the suspension). Embryo cryopreservation, on the other hand, is entirely routine. Fetal cryopreservation is somewhere in between: a possibility slightly outside current medical practice, but not essentially different from embryo storage.

The "science fiction objection" is an argument from incredulity that is best resolved with empirical research. Admittedly, it can be argued that ethicist time is too valuable to be spent on far-fetched thought experiments and ought to be focused on here-and-now problems (Nordmann 2007). However, storing embryos/fetuses is already close to existing practice, and illuminates some of the ethical assumptions going into the current abortion debate. Given the ongoing rapid emergence of new reproductive and fetal technologies, it behoves us to investigate what aspects of such a technology may change the ethical landscape of abortion.

4) Cryonics would be too costly, or would cause inequality

The cost of cryopreserving a fetus may be high, since it might require surgery in addition to the suspension process (storage is likely cheap, regardless of duration). This would make the method impractical or available to only a few.

Availability of a new, possibly morally better, option would seem to make the situation better, even if it was practical in just a few cases. The only exception would be if it were unfair for well-off people, or people in developed countries, to have access to a moral option that less fortunate people lack. But this unfairness is like the unfairness that well-off people can afford ethically sourced food and unbiased news sources: the problem is not that they have access to it, but that poor people are unable to afford it. The solution would be to make it cheaper or help the poor, not to prevent the initial uneven access. However, since both abortions and IVF techniques are provided by the health care system in most countries, it is likely that the same would happen with cryonics.

5) Fetal cryonics would postpone the beginning of the biographical life, therefore there would be a change in identity

It could be argued that, by postponing for several months or years the final development and birth of the embryo/fetus, we would affect the biographical life of this individual. It would be altered by changes in time/place/environment. In one sense, the person who eventually came into existence would be different from the one who would have been born had not the cryopreservation taken place. This is true, but it is true also for the embryos that we currently freeze and store before implanting them in utero.

Moreover, it is true for all of us if we consider various different decisions that our parents could have taken for us. For instance, if someone's parents decide to move from Europe to the US soon after she is born, her biographical life will be affected

in a similar way to the life of the person who has been cryopreserved as a result of her parents' decision to postpone pregnancy.

The fact that an embryo is implanted one year rather than another one is going to affect its biographical life, but so long as our biographical lives are in part influenced by our genetic endowment, it seems that the biographical life would only be partially altered. Moreover, since we have no way to know in advance when it would be best for such an individual to be brought into existence, this cannot be a morally relevant consideration.

Conclusion

We have argued that the use of cryonics techniques on embryos and fetuses could be a better option than several that are currently available, or than hypothetical ones such as ectogenesis. We have illustrated how cryopreservation of embryos/fetuses would avoid some of the most powerful objections to abortion, namely the objection that abortion is the impermissible killing of a human being/person and the objection that abortion interferes with the embryo's/fetus' potential development and/or its interest in having a future.

We then considered some possible advantages of cryopreservation of embryos/fetuses over abortion, ectogenesis, and IVF, and we showed that, at worst, cryonics would be no worse than abortion. We have also considered some cases where abortion would still be the best option and we have argued that the option to have an abortion should be available to pregnant women regardless of the possible future options offered by cryopreservation.

Cryopreservation of embryos/fetuses is not available (yet). However, one of the goals of this paper is to encourage discussion and research. Given that abortion is one of the most controversial practices in medicine, and given that most couples would want to have this option, it seems that it would be useful to attempt to develop this technology. We have argued that working toward the development of techniques that would offer the opportunity to cryopreserve embryos and fetuses after the beginning of a pregnancy in utero could potentially solve most of the problems related to abortion, adoption, IVF, and giving birth at an inconvenient time (for both, or either, of the parents and the child).

Notes

1. See International Committee Monitoring Assisted Reproductive Technologies (ICMART) (2012) and/or RAND Corporation (2003).
2. For more detailed information see Alcor Life Extension Foundation (2014).
3. We use the expression "embryos/fetuses" to indicate that the technology could work on either or both entities.

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