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GOING TO THE ROOTS OF THE STEM CELL CONTROVERSY

SØREN HOLM

ABSTRACT

The purpose of this paper is to describe the scientific background to the current ethical and legislative debates about the generation and use of human stem cells, and to give an overview of the ethical issues underlying these debates.

The ethical issues discussed are 1) stem cells and the status of the embryo, 2) women as the sources of ova for stem cell production, 3) the use of ova from other species, 4) slippery slopes towards reproductive cloning, 5) the public presentation of stem cell research and 6) the evaluation of scientific uncertainty and its implications for public policy.

INTRODUCTION

The ability to produce and culture human embryonic stem cells has raised hopes for a range of new cell based therapies, but has at the same time created intense national and international debate.

The purpose of this paper is to describe the scientific background to the current ethical and legislative debates about the generation and use of human stem cells, and to give an overview of the ethical issues that are central to these debates. Because the paper is intended to be reasonably comprehensive the presentation and analysis of each individual argument must necessarily be rather brief.[1]

[1] One major topic has been left out of this paper because of space constraints. That is the question of intellectual and actual property rights in human stem cell lines and the techniques by which they are produced. This is a huge topic on its own, actualising all the issues of ownership of the human body, body parts and human genetic material.

THE SCIENTIFIC BACKGROUND TO THE STEM CELL CONTROVERSY

Three partially independent scientific developments underlie the current debates about stem cell research. These are 1) the discovery of methods to derive and culture human embryonic stem cells, 2) the discovery of nuclear replacement techniques, and 3) the discovery of new and previously unsuspected potentialities of stem cells in the adult human body.

A stem cell is a non-differentiated cell that can divide and multiply in its undifferentiated state, but which can also give rise to more specialised differentiated cells. It has been known for a long time that adult human tissues contain stem cells that can replenish cells lost through normal wear and tear or through trauma or disease. This fact has been utilised as a basis for a number of different treatments including bone marrow and skin transplants.

It has also been known that cells from the inner cell mass of the early embryo are stem cells (since we know that they must necessarily be able to become every cell in the body during the development from embryo to adult individual), but no method existed by which these embryonic stem cells could be grown in culture in the laboratory in a way that preserved their stem cell character.

In 1998 researchers at the University of Wisconsin published a method for deriving and culturing human embryonic stem cells indefinitely.[2] This development made it possible to create stable human stem cell lines and generate (in principle) unlimited quantities of any particular embryonic stem cell, and thereby the possibility to 1) standardise research into human stem cells, and 2) create reproducible stem cell therapies.

Almost at the same time as the Wisconsin group developed the method for culturing human embryonic stem cells, a group at the Roslin Institute in Scotland developed methods for the cloning of adult mammals using nuclear replacement techniques.[3] The techniques basically work by removing a cell from an adult animal, and then taking the cell nucleus from the adult cell and placing it in an ovum from which the original nucleus

[2] J.A. Thomson, J. Itskovitz-Eldor, S.S. Shapiro, M.A. Waknitz, J.J. Swiergiel, V.S. Marshall, J.M. Jones. Embryonic stem cell lines derived from human blastocysts. *Science* 1998; 282: 1145–1147.

[3] I. Wilmut, A.E. Schnieke, J. McWhir, A.J. Kind, K.H. Campbell. Viable offspring derived from foetal and adult mammalian cells. *Nature* 1997; 385: 810–813.

has been removed. This procedure reprogrammes the adult nucleus to an embryonic state and creates a cell that is more than 99% genetically identical with the original adult cell from which the nucleus was taken.[4] It is, however, not the ability to reproduce a fully-grown mammal by nuclear replacement that is of main interest to the stem cell debate. It is the combination of nuclear replacement techniques and embryonic stem cell culture. When these two techniques are combined it becomes possible to produce embryonic stem cells that are almost genetically identical to any given adult human being.

Research into the potentialities of the remaining stem cells in the adult human body has also progressed apace in recent years. Stem cells have been found in a number of tissues in which it was previously 'common knowledge' that they did not exist (e.g. neuronal stem cells in the brain),[5] many kinds of adult stem cells[6] have been cultured, and adult stem cells have been shown to be capable of transdifferentiation into different kinds of cells than the cells of the tissues in which they originated.[7] These discoveries have opened the possibility that adult stem cells may be used in a range of stem cell therapies far beyond what was thought possible.[8]

At present there are thus three main research programmes that are pursued in stem cell research: 1) research on adult stem cells, 2) research on embryonic stem cells from embryos

[4] The mitochondria in this cell come from the ovum, and contain their own genetic material. It is thus only if both nucleus and ovum come from the same woman that 100% genetic identity is achieved.

[5] C.B. Johanson, S. Momma, D.L. Clarke, M. Risling, U. Lendahl, J. Friesen. Identification of a neural stem cell in the adult mammalian central nervous system. *Cell* 1999; 96: 25–34.

[6] In this paper 'adult stem cell' will be used for any stem cell derived from a human being after birth.

[7] D.L. Clarke, C.B. Johansson, J. Wilbertz, B. Veress, E. Nilsson, H. Karlstrom, U. Lendahl, J. Friesen. Generalized potential of adult neural stem cells. *Science* 2000; 288: 1559–1561; P.A. Zuk, M. Zhu, H. Mizono, J. Huang, J.W. Futrell, A.J. Katz, P. Benhaim, H.P. Lorenz, M.H. Hedrick. Multilineage cells from human adipose tissue: implications for cell-based therapies. *Tissue Engineering* 2001; 7: 211–228.

[8] Two recent papers cast some doubt on these possibilites for transdifferentiation, but their validity and relevance is contested. N. Terada, T. Hamazaki, M. Oka, M. Hoki, D.M. Mastalerz, Y. Nakano, E.M. Meyer, L. Morel, B.E. Petersen, E.W. Scott. Bone marrow cells adopt the phenotype of other cells by spontaneous cell fusion. *Nature* 2002; 416: 542–545; Q-L. Ling, J. Nichols, E.P. Evans, A.G. Smith. Changing potency by spontaneous fusion. *Nature* 2002; 416: 545–548. N. Dewitt, J. Knight. Biologists question adult stem-cell versatility. *Nature* 2002; 416: 354.

produced through IVF techniques, and 3) research on embryonic stem cells produced through nuclear replacement techniques.[9]

All three research programmes are directed at 1) increasing our knowledge about basic cell biology, 2) creating new therapies through stem cell culture and control of cell differentiation, and 3) producing commercially viable stem cell products either by the direct patenting of stem cell lines, or by combining stem cell technology with genetic engineering or other patentable interventions.

As we will see below, much of the discussion on stem cells is concerned with the ethical issues raised by each of these programmes, and with whether or not these ethical issues should influence decisions about regulation and/or funding of the research programmes.

THE EXPECTED BENEFITS FROM STEM CELL RESEARCH

Stem cell research is undoubtedly going to increase our knowledge about basic cell biology considerably, but this is not the benefit of stem cell research that excites most people. The really exciting thing about stem cell research is in the therapeutic potential of stem cells.

If we can develop methods to grow human stem cells in unlimited quantities, and if we can further learn how to control their differentiation, then a whole range of therapeutic possibilities becomes (theoretically) available.[10] The most immediate therapeutic gains are likely to be in the area of cell therapy. Many diseases are caused by, or accompanied by, loss of specific cell types. The lost cell types could be produced in the laboratory and later implanted to cure or alleviate the disease.

[9] The term 'research programme' is here used in the sense given to it by Lakatos, i.e. a group of concrete research endeavours kept together by a common core of relatively stable assumptions about the goals of research, the proper research methodologies and the most fruitful research topics. What distinguishes the three stem cell research programmes from each other is primarily different beliefs about what kind of stem cell is going to be the basis for the most progressive (i.e. productive in terms of scientific and commercial results) research. I. Lakatos. 1974. Falsification and the methodology of scientific research programmes. In *Criticism and the Growth of Knowledge*. I. Lakatos and A. Musgrave, eds. Cambridge. Cambridge University Press: 91–196.

[10] R.P. Lanza, J.P. Cibelli, M.D. West. Prospects for the use of nuclear transfer in human transplantation. *Nature Biotechnology* 1999; 17: 1171–1174; E. Fuchs, J.A. Segre. Stem Cells: A New Lease of Life. *Cell* 2000; 100: 143–155.

Further into the future it may become possible to grow whole organs from stem cells and use these for transplantation, removing the need for organ donation; and even further into the future we may be able to use stem cells for rejuvenating therapies leading to an increased life-span.

The therapeutic potential of stem cells spans such a wide range of diseases and conditions that it will constitute a major medical breakthrough if only even a small percentage of the most likely uses (e.g. in the area of cell therapy) become a reality. Even if stem cell therapy turned out only to be effective in myocardial infarction it would still alleviate huge amounts of human suffering.

These very large, and very likely benefits of stem cell research indicate that prohibition of certain kinds of stem cell research needs strong justification. The ethical and regulatory debates have therefore concentrated on whether such justification can be found.

THE ETHICAL ISSUES

Stem cells and embryos

One of the main ethical issues discussed concerning stem cell research originates in the fact that embryonic stem cells have to be generated from embryos that are destroyed in the process. This means that stem cell research again raises the question of whether there are any ethical limits concerning the destruction of human embryos for research or therapeutic purposes, as well as the more fundamental question of the moral status of the human embryo. If human embryos have any moral status we need a good justification to destroy them, and the greater their moral status the more important or weighty the justification has to be.[11]

The question of the moral status of the embryo was not resolved during the abortion debate nor during the debates about various forms of assisted reproductive technologies. It is unlikely to be resolved during the current debates about stem cells, since no really new arguments seem to be forthcoming.[12]

[11] R.M. Doerflinger. The ethics of funding embryonic stem cell research: a Catholic viewpoint. *Kennedy Institute of Ethics Journal* 1999; 9: 137–150.

[12] L.H. Harris. Ethics and politics of embryo and stem cell research: Reinscribing the abortion debate. *Women's Health Issues* 2000; 10: 146–151; D.C. Wertz. Embryo and stem cell research in the USA: a political history. *TRENDS in Molecular Medicine* 2002; 8: 143–146.

If one looks at the legislation about abortion and assisted reproductive technologies it is evident that no jurisdiction has legislation which is compatible with the view that human embryos are just things with no moral status, and that no jurisdiction has legislation compatible with the view that embryos have the same moral status as born human beings. Most legislations implicitly or explicitly adopt some kind of middle position, although it is often unclear to what extent this represents a considered view or whether it is the result of a political compromise.

The important question with regard to regulation or legislation therefore becomes how the use of embryos for stem cell research and therapy can be fitted into a legislative structure that either relies on a view that embryos have some moral value, or is a direct result of political compromise. Giving some moral status to embryos does not automatically rule out embryonic stem cell research, since it can be argued that the likely benefits in terms of reduction of human suffering and death in many cases outweigh the sacrifice of a (small?) number of human embryos.[13]

All of the ethical questions concerning the use of embryos would be by-passed if it became technically possible to produce cells equivalent to embryonic stem cells, without the creation of embryos. This could, for instance, be the case if other methods for re-programming nuclei from adult cells became available.

PPL Therapeutics PLC has claimed to have done this using bovine cells and is working towards doing it with human cells, but very few details have been released because of commercial concerns.[14]

The spare embryo

In arguments about the use of embryos for stem cell research the distinction between embryos produced for research and spare embryos left over after IVF and other forms of assisted reproduction has also been invoked. It has been argued that the use of spare embryos is less problematic than the use of embryos produced for research, and that at present the use of specifically produced embryos for stem cell research should not be allowed.[15] No new arguments to support or refute this

[13] G. McGee, A. Caplan. The ethics and politics of small sacrifices in stem cell research. *Kennedy Institute of Ethics Journal* 1999; 9: 151–158.

[14] PPL Therapeutics PLC. 2001. *Interim Report 2001.* Edinburgh. PPL Therapeutics PLC.

[15] See for instance the report from the American National Bioethics Advisory Commission. National Bioethics Advisory Commission. 1999. *Ethical*

distinction have, however, been forthcoming in the stem cell debate.[16]

Women and the need for ova

If stem cells are to be produced from embryos that are not 'spare' after IVF, the ova for this production must come from women.[17] In the initial research phase the number of ova needed will be relatively small, but for stem cell therapy the number may become very large. If, for instance, a specific therapy is based on nuclear replacement from the intended recipient in order to ensure perfect immunological compatibility, at least one ovum will be needed for each patient (and probably more since the techniques for nuclear replacement are unlikely to become 100% effective any time soon).

This raises general problems concerning how we can ensure that the ova are obtained without coercion or exploitation of the ova donors, sellers or providers, but also more specific questions about how a new practice of non-reproduction related ova procurement would influence the status of women in society.

At an even more general level there is a connection to the debate about the rights and wrongs of the commodification of human body parts.[18]

Issues in Human Stem Cell Research. Rockville. NBAC. A number of jurisdictions have legislation concerning assisted reproductive technologies that allow research on spare embryos, but prohibit the creation of embryos for research purposes.

[16] On the cogency of the distinction see S. Holm. The spare embryo – A red herring in the embryo experimentation debate. *Health Care Analysis* 1993; 1: 63–66.

[17] Unless it is possible to use ova obtained from aborted foetuses, dead women, or ovaries removed as part of surgical interventions. The first two of these alternative sources of ova may in themselves raise ethical issues but these are beyond the scope of this paper.

[18] L.S. Cahill. Genetics, Commodification, and Social Justice in the Globalization Era. *Kennedy Institute of Ethics Journal* 2001; 11: 221–238; S. Holland. Contested Commodities at Both Ends of Life: Buying and Selling Gametes, Embryos, and Body Tissues. *Kennedy Institute of Ethics Journal* 2001; 11: 263–284; L. Andrews, D. Nelkin. 2001. *Body Bazaar: The Market for Human Tissue in the Biotechnology Age*. New York. Crown Publishers; M.J. Radin. 1996. *Contested Commodities*. Cambridge, MA. Harvard University Press; R. Macklin. 1996. What is Wrong with Commodification? In *New Ways of Making Babies: The Case of Egg Donation*. C.B. Cohen, ed. Bloomington. Indiana University Press: 106–121.

Stem cells produced using ova from other species

One way of solving the problem of shortage of ova, and the potential ethical problems in using women as donors of ova for these purposes, is to use ova from other species (e.g. bovines) in the creation of stem cells by means of nuclear replacement techniques.

It is, as yet, unknown whether the use of ova from other species is technically possible, and if possible whether the stem cells produced would be functionally and immunologically equivalent to stem cells produced using human ova. The technique has been patented by the American firm Advanced Cell Technology, but there is still doubt in the scientific community whether it actually works.[19]

The additional ethical problems created by this different source of ova can, however, be argued to be small as long as the resulting embryos are only used for stem cell production and not for reproductive purposes.[20]

On some lines of argument the ethical problems may actually be less than if human ova are used, since it could be argued that the embryos produced are not really human embryos. If the moral status of human embryos is based in their being human, then the moral status of these 'less than human' embryos could be argued to be less important.

Slippery slopes towards reproductive cloning

A classical slippery slope argument has been prominent in the specific debate about whether the creation of stem cells by means of cell nuclear replacement techniques should be allowed. Opponents of this technique have claimed that allowing this would put us on a slippery slope towards reproductive cloning. The slope that is imagined is of a technical nature. If all the

[19] Advanced Cell Technology. *Advanced Cell Technology Announces Use of Nuclear Replacement Technology for Successful Generation of Human Embryonic Stem Cells*. Press Release November 12, 1998. Available at *http://www.advancedcell.com/pr_11-12-1998.html* E. Marshall. Claim of human-cow embryo greeted with scepticism. *Science* 1998; 282: 1390–1391.

[20] There are two lines of argument seeing major ethical problems in the use of non-human ova. The first sees the technique in itself as a transgression of an important boundary line between human and animal. The second points to a possible slippery slope from the use of this technique for the production of stem cells, to a use for reproductive purposes.

technical problems in the first steps of cell nuclear replacement techniques are solved succesfully then it becomes both easier and more tempting (because certain risks have been reduced) to try to use nuclear replacement techniques for reproductive cloning.

This is clearly not a problem if reproductive cloning does not raise any serious ethical problems because in that case there is no slope, slippery or not.[21]

If reproductive cloning is ethically problematic the question then becomes how to respond to the existence of the slope. The slope has to be taken seriously by politicians as a policy problem. Whatever the analysis of bioethicists as to the cogency of the belief that reproductive cloning is a serious ethical problem, there is no doubt that this belief is shared by many people and by many politicians.

The political reaction to the perceived slippery slope depends on whether it is seen as a possible threat to the positive development of stem cell research (as it is perceived by the government in the UK and a number of other European countries), or whether it is seen as a possible tool to justify the prohibition of stem cell research by nuclear replacement as part of a more comprehensive ban on all kinds of human cloning (as it is perceived by the government in the US).[22]

If the slope is seen as a possible threat to the acceptance of stem cell research the logical response is to legally prohibit human reproductive cloning, and to try to convince the public that such a prohibition will be effective.[23] Whether legal prohibition can be effective given the possibilities for international reproductive tourism to more permissive jurisdictions is, however, questionable.[24]

[21] The literature on the ethics of reproductive cloning is extensive. A range of views can be found in a thematic issue of the *Journal of Medical Ethics* 1999; 25(2), and in a thematic issue of the *Cambridge Quarterly of Health Care Ethics* 1998; 7(2).

[22] E. Check. Call for cloning ban splits UN. *Nature* 2002; 416: 3.

[23] This is the approach chosen by the governments of the UK, Denmark and the Netherlands among others. For an overview of European policies in this area see: L. Matthiessen. 2001. *Survey on opinions from National Ethics Committees or similar bodies, public debate and national legislation in relation to human embryonic stem cell research and use.* Bruxelles. European Commission Research Directorate-General.

[24] P.G. Wood. To what extent can the law control human cloning? *Medicine, Science & the Law*, 1999; 39: 5–10.

The presentation of stem cell research – Promising too much too early?

The public presentation of the benefits of stem cell research has often been characterised by the promise of huge and immediate benefits. Like with many other scientific breakthroughs the public has been promised real benefits within 5–10 years, i.e. in this case significant stem cell therapies in routine clinical use.[25] Several years have now elapsed of the 5–10 years and the promised therapies are still not anywhere close to routine clinical use.[26] There are similarities to the initial enthusiastic presentation of gene therapy in the late 1980s and the later problems encountered, and some reason to fear that stem cell therapies will have an equally long trajectory between theoretical possibility and clinical practice. It is likely that many of the current sufferers from some of the conditions for which stem cell therapies have been promised will be long dead before the therapies actually arrive.[27]

It is clearly ethically problematic to raise false expectations in seriously ill people, and even more problematic if this is partly done from self-interest (e.g. to promote one's own research in the media). But the problem may go deeper because the optimistic predictions and the targeting of these predictions on certain groups of diseases also have a function in the political arena where public policy is decided. When gene therapy was initially promoted, and the public and political resistance overcome, gene therapy was promoted as a treatment for the unfortunate people suffering from genetic disorders. Gene therapy was put forward as their only hope of cure and alleviation. Today we do know however, that most gene therapy projects are not directed towards genetic disease, but towards the treatment of common diseases (partly for commercial reasons). The groups that were used as symbolic 'battering rams' to gain political and public acceptance of the gene therapy, have not yet benefited significantly from gene therapy, and many of the people having rarer forms of genetic disorders are unlikely ever to benefit.

[25] Anon. Taking stock of spin science. *Nature Biotechnology* 1998; 16: 1291.

[26] Given the time needed for basic research, clinical research and regulatory approval it is unlikely that any therapy using biological materials, and based on a truly novel therapeutic approach could move from initial discovery to clinical use in 5–10 years. See also R. Lovell-Badge. The future for stem cell research. *Nature* 2001; 14: 88–91.

[27] B. Albert. *Presentation to the All-Party Disablement Group* – July 25th 2000. Unpublished manuscript.

Scientific uncertainty, ethical unease and the formulation of public policy

At the current point in time it is not known which (if any) of the three main lines of research described above is going to be most successful in terms of a) generating scientific knowledge about cell biology, and b) generating new stem cell based therapies for common diseases. That each is, at least at the moment, seen as a viable approach with regard to therapy is attested by the fact that many biotech firms have been founded aiming at exploiting each of the approaches.[28]

The question is important because it has been argued that there is no need to permit more ethically contentious ways of generating stem cells, if the same benefits can be realised using less contentious stem cells, either adult stem cells or stem cells from aborted foetuses.[29]

What factors could we use to decide whether one line of research is more promising than another?[30] One possibility is to think about what characteristics a stem cell should have in order to be therapeutically useful and then try to decide which of the research programmes is most likely to be able to lead to the production of such cells, and if more than one can produce the required cells, which one will progress fastest to the goal.[31] We do know (some of) the characteristics that the therapeutically optimal stem cell should display:

1. No immunological rejection
2. Immediate availability

[28] N. Axelsen. 2001. Commercial interests in stem cells. In *Nordic Committee on Bioethics. The Ethical Issues in Stem Cell Research*. Copenhagen. Nordic Council of Ministers: 79–80.

[29] J.R. Meyer. Human embryonic stem cells and respect for life. *Journal of Medical Ethics* 2000; 26: 166–170; V. Branick, M.T. Lysaught. Stem cell research: licit or complicit? Is a medical breakthrough based on embryonic and foetal tissue compatible with Catholic teaching? *Health Progress* 1999; 80: 37–42. This kind of reasoning also seems to underlie the National Bioethics Advisory Committee report *op. cit.* note 15, although it draws the line of contentiousness between the spare embryo and the embryo produced for research.

[30] Most of this debate has centred on the therapeutic uses of stem cells. With regard to the 'pure' scientific production of knowledge about cell biology it seems clear that each of the research programmes will produce at least some unique bits of knowledge, and that each of them must therefore be pursued if complete scientific knowledge is the goal.

[31] A difference in speed of development between two research programmes is important, even if they will both eventually lead to the same goal, since any delay in implementation of stem cell therapies entail costs in term of human suffering.

3. Availability in large numbers
4. Controlled differentiation to desired cells
5. Controlled integration into existing tissues and biological niches leading to normal function
6. No other biological risks

From a theoretical point of view embryonic stem cells created by nuclear replacement should be able to fulfil most of these requirements. We know that they can become all types of cells, and we know that they are immunologically perfectly compatible. We are, however, not yet able to control their differentiation into all desired cell types, and there may be situations of acute organ or cell failure where we do not have the necessary time to grow a sufficient number of cells to initiate therapy in time.

Embryonic stem cells derived in other ways have the disadvantage of not being immunologically perfectly compatible, but they do, on the other hand, offer the advantage of being potentially immediately available from a stem cell bank in the necessary quantities. Adult stem cells are immunologically compatible, but it is still uncertain whether we can derive all types of cells from adult stem cells, and they may also not be available in sufficient quantities in acute cases.

No type of stem cell therefore fulfils all the criteria for a therapeutically optimal stem cell. How should we evaluate this evidence in order to decide what research programmes to pursue?

At approximately the same time, the American National Bioethics Advisory Commission and a British government expert group reviewed the evidence and came to two rather different conclusions. The National Bioethics Advisory Commission concluded that:

> Currently, we believe that cadaveric fetal tissue and embryos remaining after infertility treatments provide an adequate supply of research resources for federal research projects involving human embryos. Therefore, embryos created specifically for research purposes are not needed at the current time in order to conduct important research in this area.
> [...]
> We conclude that at this time, because other sources are likely to provide the cells needed for the preliminary stages of research, federal funding should not be provided to derive ES cells from SCNT. Nevertheless, the medical utility and

> scientific progress of this line of research should be monitored closely.[32]

Whereas the British Chief Medical Officer's Expert Group concluded that:

> For some people, particularly those suffering from the diseases likely to benefit from the treatments that could be developed, the fact that research to create embryos by cell nuclear replacement is a necessary step to understanding how to reprogramme adult cells to produce compatible tissue provides sufficient ethical justification for allowing the research to proceed.[33]

What was a fact for one group of experts was clearly not a fact for the other. What is at play here is a different evaluation of the available scientific evidence, but possibly also a different approach to the decision of whether a line of research should be deemed 'necessary'. Is a particular line of research only necessary if it is the only way to get the knowledge we need for stem cell therapies, or is it necessary if scientific progress will otherwise be slowed down and will be much more costly, but will eventually lead to stem cell therapies any way even if this particular line of research is not pursued?[34]

The policy-maker is thus left with a very difficult problem. If we knew that adult stem cell research could deliver therapies for all the conditions where stem cell therapy seems to be a possibility, then there would be a straight forward policy argument for choosing only to support this ethically uncontentious research programme. If the same goal can be obtained in two ways, and if one of them is less contentious than the other it makes good political sense to choose the uncontentious one.[35] If on the other hand there was unequivocal certainty that research using embryonic stem cells was necessary for the development of stem cell therapies for one or more important diseases, a relatively

[32] National Bioethics Advisory Commission, *op.cit*, note 15, pp. 71–72.

[33] Chief Medical Officer's Expert Group. 2001. *Stem Cell Research: Medical Progress with Responsibility – A Report from the Chief Medical Officer's Expert Group Reviewing the Potential of Developments in Stem Cell Research and Cell Nuclear Replacement to Benefit Human Health.* London. Department of Health. p. 40.

[34] S. Holm. 2001. European and American ethical debates about stem cells – common underlying themes and some significant differences. In *Nordic Committee on Bioethics. The Ethical Issues in Stem Cell Research.* Copenhagen. Nordic Council of Ministers: 35–45.

[35] This might be the proper policy response even if it would lead to some delay in the development of treatments.

strong consequentialist argument would offer itself based on a moral imperative to reduce human suffering, and this could be combined with appeals to consistency in those jurisdictions that already allow some kinds of embryo research.

Because there is scientific uncertainty each of these two lines of argument is, however, considerably weakened because an opponent can always point to uncertainty about the underlying empirical premises concerning whether embryonic stem cell research is necessary or not.

CONCLUSION

It should by now be evident that many of the most discussed ethical issues in connection with stem cell research are minor variants of issues that have been discussed in reproductive ethics since the beginning of modern bioethics in the late 1960s and early 1970s. Many arguments in the stem cell debate, for instance, merely re-iterate arguments for or against giving moral status to embryos, or arguments concerning the validity of the distinction between 'spare' embryos and embryos produced specifically for research. The underlying points of contention in these recycled arguments have not been resolved during the abortion debate, or during the debates about assisted reproductive technologies, and they are unlikely to be resolved now. Each side has arguments that it sees as compelling, but which the other side rejects utterly. It is probably this re-ignition of old debates that has added to the heat of the stem cell debates, because neither side can give ground without fearing a knock on effect on the political accommodations or compromises reached in the abortion and the assisted reproduction areas.

If we take all of these already well known debates into account it seems that there is a rough hierarchy of contentiousness ordering the different ways of producing human stem cells according to how many issues each raise. This would look something like the following (with the most contentious first):

Embryonic stem cells created by nuclear replacement
Embryonic stem cells from embryos created for research
Embryonic stem cells from spare embryos
Adult stem cells

This proposed hierarchy is not very illuminating for ethical analysis, but it may well influence public policy.

There are, however, also a few issues raised by the stem cell debate that are not as well worn. The most interesting of these

are the questions surrounding how public policy should be formed in an area where there is 1) agreement about the value of the goal of a particular kind of research (i.e. the creation of effective stem cell therapies), 2) genuine scientific uncertainty about exactly what line of research is most likely to achieve this goal, and 3) disagreement about the ethical evaluation of some of these lines of research but not about others. This question is perhaps more a question of political or legal philosophy than a question of ethics, but it is nevertheless an issue that should be of interest to those bioethicists who want their elegant analyses transformed into public policy.

Søren Holm
Institute of Medicine, Law and Bioethics
University of Manchester
Manchester M13 9PT
UK
Soren.holm@man.ac.uk