

**Pathology Project: Exploring the ethics of  
human embryonic and foetal stem cell  
research in medicine**

*By Heather Davis*

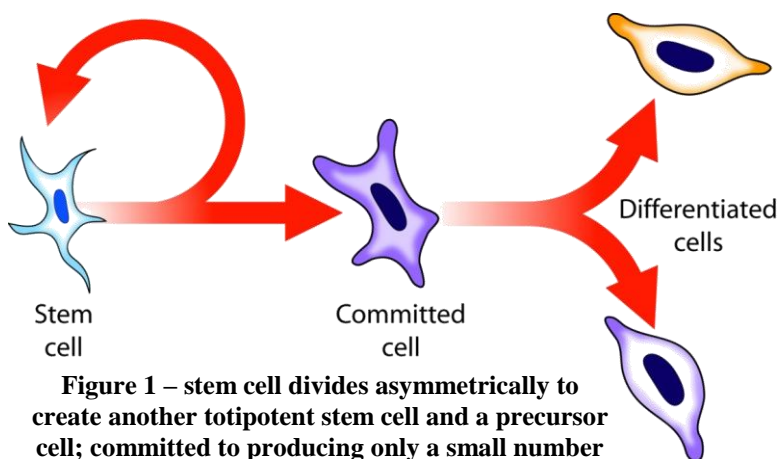
**PASS WITH DISTINCTION**

**Abstract**

L.M. Guenin of Harvard Medical School, said ‘We honour human life by probing our moral views to their foundation’<sup>1</sup> We live in an age of technology where the impossible is becoming possible; ethics and morality self-impose rules that ensure humanity does not degrade. ‘November 1998 James Thomson’<sup>2</sup> was the first scientist to establish a human embryonic stem cell line by removing cells from *spare* embryos at fertility clinics, thereby killing them and launching an ethical debate which still wages today. This paper explores some of the ethical arguments in this debate, focusing on the extremes of utilitarian and Catholic ethics of embryonic stem (ES) cell research and foetal stem cell research.

**Introduction**

To understand the debate we must understand the key scientific concepts shaping it. Stem cells are unique: they are undifferentiated so they can develop to form any specialised cell - giving ‘rise to more than 250 specialized cells in the body’<sup>3</sup>. Stem cells can divide infinitely to produce identical daughter cells, or they can divide asymmetrically producing one cell identical to the parent (which ‘continues to contribute to the original stem cell line’<sup>4</sup>) and one cell, which although containing the same DNA has different parts *turned on* (therefore is expressed differently). [See figure 1] This cell exhibits a ‘reduced proliferative capacity’ and unlike its parent is not totipotent (it exhibits limited development potential from this first stage of differentiation).



**Figure 1 – stem cell divides asymmetrically to create another totipotent stem cell and a precursor cell; committed to producing only a small number of terminally differentiated cells**

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**Sources of stem cells**

While this report focuses on the use of human embryonic stem cells we must remember there are other sources of stem cells, including cord blood and SCNT (Somatic Cell Nuclear Transfer). Mature stem cells have been identified in many adult human tissues. They exist within differentiated tissue (by definition they are unspecialised and can proliferate indefinitely) but their potential differentiation is limited to cells associated to the differentiated tissue from which they originate, this is known as multipotency. They have been identified within numerous human tissues but the best described are haematopoietic stem cells within the bone marrow because ‘a variety of cell surface and genetic markers have helped delineate various stages of their differentiation’<sup>5</sup> in formation of blood cells – haematopoiesis.

However, as well as the haematopoietic stem cells, mesenchymal stem cells exist within bone marrow. These ‘have been shown to differentiate in vitro into various cell

lineages including neuronal cells, as well as cartilage, bone and fat lineages'<sup>6</sup> (therefore exhibiting multipotency). We can track stem cells after adult bone marrow stem cell transplants; if a female patient received male donor cells we track these by identifying the locations of the Y chromosomes in the body. 'Biopsy or post-mortem samples show that some of the transplanted bone marrow stem cells could form liver, skin, and digestive tract cells, as well as participate in the generation of new neurons within the human brain.'<sup>7</sup>

Recent research has identified cells from human testes can become embryo-like stem cells 'when provided with the correct set of growth factors, the cells took on the characteristics of embryonic stem cells'.<sup>8</sup> Whether these cells are totipotent or pluripotent remains to be seen. Although there isn't such a wealth of information on other types of adult stem (AS) cells they too show promise and some of the problems mentioned may be solved if new techniques are found, allowing us to utilise AS cells in healthcare mainstream.

AS cells are surprisingly versatile and therefore display clinical promise in regenerative medicine, yet they are not without problems. It is difficult to maintain proliferation of AS cells (of which there are few to begin with therefore affecting therapeutic value 'the change to the desired heart and blood vessel cells occurred in only 0.02% of cells...the cells capable of change may be very few in number'<sup>9</sup>) within culture. 'If adult cells have a restricted renewal potential, this will have negative implications for therapeutic applications'<sup>10</sup> effective transplantation relies on the ability to proliferate cells. Unlike AS cells ES cells 'exhibit high levels of the enzyme telomerase which indicate their "immortality"<sup>11</sup> –generally there is far more data demonstrating ES cells are 'capable of indefinite growth and pluripotency than adult stem cells'<sup>12</sup>. Furthermore it is dubious if the AS cells identified in studies conducted are what they are claimed to be. 'Jackson *et al* presented data to suggest that a group of muscle cells could turn into blood cells, they later found they were dealing with a subpopulation of cells that normally reside in muscle tissue'.<sup>13</sup>

There may be 'exceptions to the generalization that adult stem cells give rise only to cell types found within their own broad type of tissue'<sup>14</sup>. But these exhibit shorter lives (and are therefore less therapeutically useful). Generally, 'as stem cells within a developing human embryo differentiate in vivo, their capacity to diversify generally becomes more limited'<sup>15</sup>. AS cells, by definition have been subject to environmental toxins, 'accumulated a lifetime of genetic mutations'<sup>16</sup>, 'age stresses... and often disease'<sup>17</sup>. Because of this 'adult stem cell are understood to be 1/1000 as powerful as cord stem cells... their use is limited by the risk of Graft versus Host disease and often a problem of finding a HLA matched donor.'<sup>18</sup>.(GVHD is a very serious complication following marrow transplants.) Although ES cells 'grow much more readily'<sup>19</sup> many studies have shown 'higher doses of more primitive cells are the very ones likely to produce tumours'<sup>20</sup>

### **Potential of stem cells**

After fertilisation the dividing embryo travels along the fallopian tube to the uterus, by then it has formed a blastocyst [see figure 2] containing around '200 cells'<sup>21</sup>. The embryo has not yet divided into the ectoderm, mesoderm and endoderm. The blastocyst is essentially a 'thin-walled hollow sphere made up of an outer layer of

cells, a fluid filled cavity, and an inner cell mass (ICM) containing pluripotent stem cells<sup>22</sup> Normally the ICM would go on to form the body of the embryo but when the embryo is used for stem cell research, these cells are taken the organism is destroyed.

Stem cells are potentially medicinally and scientifically valuable, although this report focuses on medical therapies, stem cells do ‘provide a wonderful tool for the study of cellular and developmental processes’<sup>23</sup>. They exhibit immense therapeutic potential –a summary of some uses follows:

On 03/12/08 it was reported that researchers at Imperial College London have been ‘able to grow functioning heart muscles and to be able to beat in time’<sup>24</sup> and hope to replace infarctions following heart attacks, therefore hopefully reversing disease and increasing life span.

In another incidence, AS cells were used in ‘autologous non-myeloablative haemopoietic stem-cell transplantation’<sup>25</sup> in 21 adults following which ‘81% improved by at least one point on a scale of neurological disability’ the trial demonstrated ‘not only is progression of disability halted, but damage appears to be reduced.’<sup>26</sup>

In the case of Claudia Castillo, who had a damaged left bronchus from tuberculosis, AS cells were used, and a donor trachea (forming the original collagen *scaffolding*) to engineer a new bronchus which was transplanted into Claudia. ‘Four days after transplantation the hybrid windpipe was almost indistinguishable from adjacent normal airways’<sup>27</sup>.

Stem cells are demonstrably used in regenerative medicine and transplants but there are many other clinical applications including treating cancers, autoimmune diseases and corneal scarring.

### Stimulus

A team in Glasgow are planning a trial assessing the regenerative effects of ES cells on stroke patients. ‘Cells made from a human foetus will be injected into patients’ brains. It is hoped the cells will regenerate areas damaged by stroke, and increase patients’ movements and mental abilities’<sup>28</sup> The procedure has shown promise in animal model systems and ‘may allow new nerve cells to grow or regeneration of existing cells and actual recovery of function in patients who would not otherwise be able to regain function.’<sup>29</sup> 2/3 of stroke patients never fully recover despite efforts to restore movement and brain function through physiotherapy, stem cells may present a means of recovery for those that physiotherapy has failed.

### Ethical Issues in Using Embryonic Stem Cells

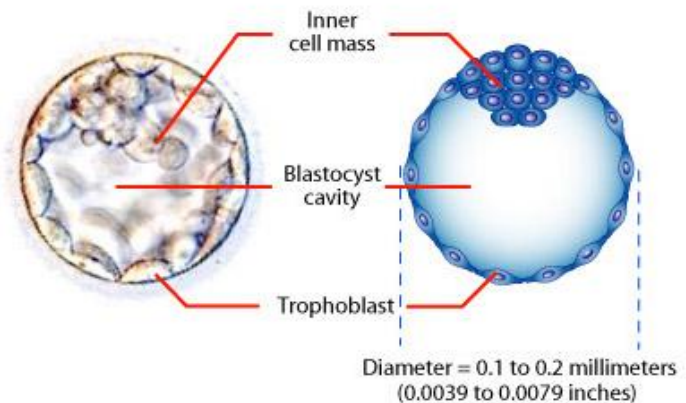


Illustration by [Cell Imaging Core](#) of the Center for Reproductive Sciences.

**Figure 2 – Zygote divides to form a blastocyst (5days after fertilisation.) Stem cells are extracted from the ICM – if implanted in the uterine wall the blastocyst undergoes further development**

This trial uses an aborted foetus to obtain the stem cells. The basis of the ethical arguments surrounding ES cell research is the point at which *personhood* can be awarded. If the embryo is a person when destroyed this poses immense ethical difficulties, if the embryo is not a person it should not matter.

At fertilisation the DNA needed for future development is present; the zygote has the potential to develop into a person, prompting some to believe personhood should be awarded at fertilisation, valuing the potential of the embryo rather than its current state of development. However the nonindividuation objection says 'prior to formation of an embryo's primitive streak at day 14 of development, it can happen that the embryo splits into monozygotic twins. And if twinning occurs, the twins can fuse.'<sup>30</sup> conflicting with zygotic personhood. We cannot know until 14 days after conception if multiple individuals will form in the uterus or not. Can we award personhood to an individual that then splits forming two daughter embryos? Does this mean the two daughter embryos are *half people*? It has been suggested that by the embryo dividing it has effectively ceased to exist and has been replaced by two daughter embryos, solving the problem.

Catholic ethics demand zygotic personhood. 'The human being must be respected – as a person – from the very first instant of his existence... Life once conceived, must be protected with the utmost care'<sup>31</sup> This teaching stems from scripture 'For it was you who formed my inward parts; you knit me together in my mothers womb'<sup>32</sup> this demonstrates that God both created (and therefore the life is sacred) and planned the life of the embryo and so only he can take the life – it is not the place of any other being. It is this belief that makes embryonic research illicit – it is 'opposed to human dignity'<sup>33</sup> because the embryos cannot give consent for their sacred lives to be sacrificed, which in itself would be breaking the commandment do not kill (so would not be allowed.) Specific to the stimulus 'the corpses of human embryos and fetuses, whether they have been deliberately aborted or not, must be respected just as the remains of other human beings.'<sup>34</sup>

Although the church condemns abortion it happens nonetheless, after which the foetus is burnt. "Foetal tissue" is put into a large plastic tub, along with all the other "products" of the rest of a day's work at the clinic. The tub is sealed and securely stored by the clinic until it is taken away by a specialist clinical waste firm to be incinerated.'<sup>35</sup> Surely the church would rather endorse stem cell research involving these fetuses (the lives of which are already prevented continuing by the abortion) to help relieve suffering, rather than destroy them at no gain?

The church has not always awarded zygotic personhood. St. Augustine wrote 'If what is brought forth is unformed (informe) but at this stage some sort of living, shapeless thing (informiter), then the law of homicide would not apply, for it could not be said that there was a living soul in that body, for it lacks all sense, if it be such as is not yet formed (nondum formata) and therefore not endowed with its senses'<sup>36</sup>. From this, the right to life (and personhood) is not awarded until ensoulment (the soul enters the body); it implies we cannot know this has taken place until the foetus is conscious and can sense things. This is apparent in amniocentesis (generally 'performed between 15-20 weeks of pregnancy'<sup>37</sup>) 'the foetus often guides the needle away.'<sup>38</sup> suggesting a sense of self awareness. But up to the 14<sup>th</sup> day of gestation 'the blastocyst has no central nervous system and, in our view, cannot be considered sensate'<sup>39</sup> Current UK

law 'forbids laboratory nurture of embryos beyond day 14.'<sup>40</sup> it seems they have awarded personhood at 2 weeks (however abortions are allowed until 24 weeks into pregnancy, when the foetus is viable), denying zygotic personhood. This may prevent stem cells being used from some aborted foetuses, but would endorse ES cell research done using blastocysts.

The church changed its position in 1869; Pope Pius XI declared a foetus is a human person from conception, extending the belief 'corpore et anima unus'<sup>41</sup> - the body and soul are one, to zygotes. Yet Aristotle, one of the most influential philosophers to Aquinas and the Catholic Church, did not believe that this could be extended to a zygote bearing no resemblance to a human in early pregnancy [see figure 2]. He opposed zygotic personhood, favouring hylomorphism – (belief substance is both form and matter) so 'a being without a brain cannot house an intellectual soul'<sup>42</sup>. This permits stem cell research before brain formation – and therefore before ensoulment (and therefore personhood and rights attributed to persons.) St. Thomas Aquinas, wrote 'Besides, Aristotle says that the embryo is an animal before it is a man'<sup>43</sup> demonstrating the embryo is not recognised as a person prior to formation of the brain. Current in-uterine development understanding of the brain shows it begins development at 'week 3 of gestation'<sup>44</sup> therefore the dates stated by Aristotle and Aquinas of ensoulment 'the conception of a male is not completed... until about the fortieth day, as Aristotle says in the 9<sup>th</sup> de Animalibus; that of a female not until about the ninetieth day'<sup>45</sup> are weak because they contradict Aristotle's beliefs about the brain and soul.

The Church also express concern too much importance is put on physical, rather than spiritual, perfection; implying they favour palliative care. For some this is unethical, withholding the technology of stem cells which could potentially alleviate suffering of many, and yield therapies for some diseases/ conditions completely. If this technology were developed it may well remove all need for palliative care. For some the duty to relieve suffering, which indeed is motivation for most medical personnel, is enough to permit using ES cells. What better way to show respect for human life than to completely cure the condition, and stop that suffering? 'The cause of curing disease has a human face, the face of a loved one or neighbour, bent under the suffering of an incompletely understood or treated disease... to know is linked to a desire to relieve'<sup>46</sup> Advocates argue that 'the pain and suffering of those in need should outweigh concerns for human embryos frozen in a laboratory'<sup>47</sup>, this can be applied, perhaps more so, to the use of stem cells from aborted foetuses - these can never live again and will be burnt rather than frozen ('under U.K. law, an embryo ordinarily may be stored for only 5 years'<sup>48</sup> before they too are disposed of.)

This approach echoes Utilitarian ethics; an ethical system based on the maxim the *greatest good for the greatest number*. Few embryos need destroying to create a stem cell line which could help millions of suffering people. Even if the embryos are persons a Utilitarian would permit the sacrifice of these embryos for the good in healing of many more. 'Early embryos... do not have the capacity to feel pain and so cannot be measured according to the hedonic calculus'<sup>49</sup> therefore the relief which can be potentially brought about by utilising these embryos outweighs any cost to the embryo's life. Yet we must consider costs to the NHS and likelihood of success; if the NHS were to spend a large proportion of its budget on ES cell research and make no headway, it would've been wasted and therefore the embryo's assumed preference to

live would outweigh the good in satisfying human curiosity. Opponents would point out that we are yet to see any benefits from ES cells. *Do No Harm the coalition of Americans for research ethics*<sup>50</sup> published a fact sheet listing 73 benefits of AS cells to human patients and none by ES cells. Nonetheless ES cell advocates believe ‘research is hampered by current regulations, and it is difficult to succeed with one hand tied behind one’s back... It takes time and a great deal of money to translate fundamental discoveries into clinically useful treatments.’<sup>51</sup>

Some have suggested taking ES cells is ‘effectively the same as taking organs from donors after their deaths.’<sup>52</sup> We herald adults donors as heroes yet *embryonic donors* are to be protected from donating (both the aborted foetuses and organ donors are already dead – unlike the embryos used in stem cell research, which are killed for stem cells). There is a vast flaw in this argument; adults we can *choose* to donate organs (however there is ongoing debate over whether we should have this right) – an embryo is unable to make such a choice. This is the main objection in autonomy ethics, removing the embryo for the stem cell research, effectively removes its freedom of being. They command we treat the embryo as any other human who we are unsure if they consent to donate or not – and respect the integrity of their body and therefore maintain their dignity.

Zygotic personhood ignores that a baby cannot develop unless the blastocyst implants into the uterine wall. ‘Only about 20-30% of blastocysts actually manage to do this; 70-80% of successful fertilisations do not result in a pregnancy.’<sup>53</sup> This suggests the embryo cannot be a person unless it has implanted in the uterine wall, for only then do we know if it will result in a life or not. But these embryos are still potential pregnancies - for some removing this chance, however small, is still wrong. It deliberately prevents implantation and therefore all hope of the embryo progressing to birth/personhood (if personhood is not awarded already.) If personhood is not awarded until implantation, the embryo has no rights until then, including the right to life so it would be morally acceptable to take ES cells (thereby killing it).

## **Conclusion**

Doubtless, the argument surrounding ES cells will continue unless AS cells render them redundant; there is no definitive resolution. Currently neither technology (especially ES cells) has been fully exploited - for some limiting ourselves is thought to be more wrong than destroying the lives of potential people. The stem cells have the potential to save thousands of lives, and if not save life – improve or extend it and we should utilise this because we have a duty to relieve the suffering of the many (despite harming a minority.) This duty cannot be fulfilled with the compromise of palliative care we could cure the patients altogether.

The deontological approach (as with catholic ethics which promote the sanctity of human life) ignores the consequences of an action however desirable it is. Destroying another human life, no matter how early in development it is, is always intrinsically wrong and cannot be outweighed or justified.

Situation ethics serves some middle ground between these extremes, examining motives for research. For ES cell research to be morally acceptable it must be done for the right reasons (to relieve suffering.) If not human life begins to be degraded and

could lead to the degradation in other areas leading to a *slippery slope* where the lives of different individuals may not be valued equally and persecuted. The European Patent Office has already rejected a patent ‘covering the use of human embryonic stem cells’<sup>54</sup> allowing the company to enforce others to pay to use ‘virtually any application of human embryonic stem cells or cells derived from them’<sup>55</sup> - this would have meant the research benefits would only be seen by those who could afford it. This is not an ethical motive for conducting ES cell research and would not justify killing the embryos to obtain the stem cells.

I believe we have a duty to utilise the ES cells from spare IVF treatments –these will never have the opportunity to implant into a uterus and so can never develop into a person, as with aborted foetuses. Out of respect for the born, suffering person ES cells should be utilised in research (with the mother’s consent) rather than destroyed at no use to anyone. There is no right or wrong answer, we must wait and see the public’s reaction – for it is this the law represents, it is the law that will determine how ES cell research progresses.

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