Article

Exploring Gamete Distribution for Somatic Cell Nuclear Transfer Embryonic Stem Cell Procedures

Amelia Safai

Abstract

Somatic cell nuclear transfer is a modern technology most famously known for producing clones, such as 'Dolly' the sheep. However, its purpose is being explored in what is called 'therapeutic cloning.' This is the process of using somatic cell nuclear transfer to produce embryonic stem cells (ntESC). These stem cells can then be used in a variety of treatments, such as organogenesis and ailments for chronic illnesses such as type II diabetes. Australia has recently lifted the ban on research conducted into somatic cell nuclear transfer testing, and thus, the question arises of how an already-strained gamete pool can be distributed towards ntESC procedures. Firstly, using Rawls' 'veil of ignorance', the concept of a waiting-list structure is considered due to its unbiased nature. Then, the permissibility of such a list will be analysed from the perspective of ntESC technology potentially being critical for time-restricted scenarios. It is thus concluded that a gamete waiting list for ntESCs is conditionally just if patients are not in dire situations.

Keywords:

Somatic cell nuclear transfer, stem cells, gamete distribution, therapeutic cloning, veil of ignorance, ethics.

Introduction into Somatic Cell Nuclear Transfer

To understand the benefits and current limitations of the technology, it is crucial to learn the role gametes play in therapeutic cloning. A donor fertile oocyte (an immature egg cell) has its nucleus removed, or enucleated, during metaphase II (Matoba & Zhang, 2018). The nucleus from the recipient, which contains genetic information, from one of the patient's cells is inserted into the enucleated oocyte using a glass pipette (Kfoury, 2007). The oocytes altered with the patient's nucleus are then fused using electro pulses, which also starts development. Development occurs until a blastocyst, around 40-150 cells, is formed (Matoba & Zhang, 2018). At this stage, scientists can then direct differentiation of the stem cells found along the blastocyst. Differentiation is conducted using growth-hormones which are specific to the desired cell type. These cells replicate further. Once there is a suitable number for treatment, the cells can then be used to treat the patient. These newly created cells will all be nuclear genetic clones of patient cells.

Potential Treatments

Such treatments include creation of tissue, and possibly organogenesis, for those who need transplants (Kfoury, 2007). In 2021 alone, 1250 Australians lost their lives to causes which could have been prevented by earlier organ transplants (Organ and Tissue Authority, 2022). Furthermore, recent years have shown a steady decline in interest for organ donations, with a 9% decrease in deceased organ donors this past year (Organ and Tissue Authority, 2022). There is a clear need for more organs in Australia, with ntESC technology potentially being key to filling the gap. Also, organogenesis allows for specificity of tissue, which would mean a more tailored treatment, and thus, a more likely successful operation.

Organogenesis is not the only potential benefit of ntESC technology. Trials have shown promise in reducing chronic illnesses such as Type I diabetes and Parkinson's. For example, scientists successfully created patient-specific insulin-producing cells, beta-cells, using ntESC technology (Yamada et.al., 2014). These beta-cells have the potential to replace unhealthy counterparts in a patient with Type-I diabetes, thus alleviating their disease. This is significant as it is estimated that $2.9 billion dollars a year is lost to type I diabetes alone in Australia (Juvenile Diabetes Research Foundation Australia, 2021). Such treatments have the potential to lower costs spent on chronic illness annually, while benefiting a patient's treatment, although further research is a necessity.

Gamete Distribution

While the technology has the potential to limit costs of chronic illnesses, it is hard to pinpoint how expensive it will be. The research is still in its infancy, and thus, arguments over its total cost are challenging to analyse. However, it is evident that this technology is extremely reliant on using gametes to grow stem cells, which may create limitations. In Australia, paying for egg cell donation is illegal, and donors are not anonymous (Watkins, 2021). There is currently a shortage of eggs throughout the country, with many gametes being shipped from the United States (Pennings, 2018). Another issue is somatic cell procedures would pull the most viable eggs away from in vitro fertilization (IVF) procedures (Waldby & Caroll, 2011). This is because to ensure blastocyst formation, the most viable, or the most likely to be fertilized eggs are chosen. When 20 Australian IVF

patients were interviewed on whether they would donate for ntESC research, 16 responded 'no' and 4 responded 'unsure' (Waldby & Caroll, 2011). It is suggested that these patients have an unwillingness to donate to ntESC due to their most valuable gametes being needed. Women donate directly to certain research fields, and IVF gametes will not be used for ntESC without consent of the donor. Thus, the requirements of gametes and the lack of monetary compensation for volunteers will likely result in a further shortage of eggs for ntESC research and procedures. How will these few gametes, and in turn, ntESC procedures, be distributed?

Rawls' Theory of Justice

As mentioned, paying for gametes in Australia is illegal (Watkins, 2021). Thus, donated gametes would not be distributed based on monetary means, but rather another system. To create a 'just' or fair way of organising gametes for ntESC, Rawls' theory of justice can be applied. Rawls lays out the concept of a 'veil of ignorance' (Freeman, 2019). This is the idea that if goods were to be handed out randomly, a participant with no knowledge of their needs and others' needs would hope for an equal distribution to ensure they receive no less than others. Thus, every person would receive the same amount of goods in this 'just' scenario. Socio-economic status, race, gender, and age would not play a factor in the decision of distribution (Freeman, 2019). To apply this to the donated gametes, every patient in need would have access to an equal number of viable gametes. However, due to the shortage, this process may require a new waiting list, like the one for current IVF practices which normally has a wait time of six weeks (Waldby & Caroll, 2011). This waiting list would allow any Australian in need to apply and receive quality gametes needed for the ntESC procedure.

While it seems simple under Rawls' principle to agree to a waiting list structure, ntESC technology may involve more high-risk scenarios than IVF procedures. For IVF, women are not in immediate danger and have the capacity to wait for six weeks. However, as described, ntESC has the possibility of producing new organs and tissues. If someone has an emergency, such as a car accident which punctures their lung, would putting them on a waiting list be just? The patient waiting for gametes may die within that time. In a way, a waiting list may be unjustly favouring those who are healthier over those who are in high-risk scenarios. The waiting list would ensure the justice of fair distribution under the basis of wealth, age, gender, and race, but it would be at the risk of human life. Thus, perhaps a conditional approach to Rawls' theory of justice should be taken. Such as, a waiting list for gamete distribution is only morally permissible if patients are not at immediate risk of death. Clearly, there will be patients in imminent danger needing this technology, so it can be concluded that a waiting list on its own is not the correct or fair solution to gamete distribution for ntESC technology. Another solution should therefore be explored.

Conclusion

Therapeutic cloning has the potential to cure acute and chronic illnesses and create new, patient-specific organs. However, its reliance on gametes creates issues for distribution of gametes for the application of the technology. A proposed waiting list structure is just under Rawls' theory of justice if patients are not in imminent danger. Otherwise, another approach is required, perhaps allocating a portion of gametes for emergency supply,

where patients who will die within a specified amount of time are immediately given gametes, although more analysis is needed to verify the effectiveness and fairness of such a system. While the technology may still be in its infancy, it is crucial to consider such scenarios to ensure Australia can effectively and justly treat patients in the future.

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