

## Live cell therapy: Past, present and future

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### Abstract

In reality, the history of xenotransplantation is the history of stem cell transplantation. The process of using fetal and young tissues' of animal origin for their inherent biological capacity for development to treat disease and restore key bodily processes while promoting health has historically been known as "cell therapy." Medical professionals have been using cell therapy for more than a century. It all began empirically in the early 1900s. Numerous cell therapy publications, including a lot of ground-breaking research, can be found in non-Anglophone media. These have largely been overlooked or not been read. The majority of current research focuses on the biology and use of cells with human ancestry. This paper will examine previous, present, and future research in live cell therapy and its therapeutic uses in regenerative medicine. The limitations of the many human-derived stem cell types and problems with safety and efficacy will be hinted at. Live cell therapy using fetal precursor stem cells of animal origin generated by "state-of-the-art primary tissue cultures" will be highlighted for its biology and clinical applications. No genetic engineering is involved in the manufacture of these cells, and like the earlier method of cell therapy utilizing fresh cells, they are all implanted without immunosuppression. More research into the biology of fetal precursor stem cells produced from animal fetuses and their clinical use could help clarify the therapeutic application of this mostly unexplored therapy option and better understand the mechanism underlying the beneficial results in people treated.

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### History

Stem cell xenotransplantation or "cell therapy", has a much deeper history than stem cell transplantation and allogeneic transplantation. According to ancient Hindu texts, the historical roots date back more than 4000 years. In 2,400 BC, Susrata wrote about using juvenile tigers' genital glands to alleviate impotence. Stem cell xenotransplantation was introduced into clinical practice in 1931 (Molnar 2006). This followed the well published reports of a dramatic immediate response to treatment by Paul Niehans in a patient with severe post-operative tetany following a total thyroidectomy (see historical reviews by Deschamps et al., 2005; Cooper et al., 2015)

Organ transplantation has historically lagged decades behind stem cell xenotransplantation. Transplanting freshly obtained animal fetal tissue fragments of various organs into humans is referred to as "cell therapy." Sheep, cattle, and pigs were the main sources of stem cells. Contrary to allogeneic and stem cell transplantation, cell therapy started with empirical experience. In Germany alone, physicians employed frozen and lyophilized cells to treat more than four million patients up until 1987 (Molnar 2006). The anticipated number may exceed 8 million if patients from the USSR and other European nations are included). Most publications were written in German and

Russian. Only after the 1960s do publications in the anglophone media start to appear. Cell therapy has been described as the safest form of biotherapy (Molnar, 2006).

The primary goal of live cell therapy is the restoration of cellular function and all of its functional partners, including tissues and organs. Following the correction of the biochemical perturbations, the patient's physical, mental, and spiritual well-being should also improve further, as symptoms should disappear. The treatment is holistic and must take into account the patient's specific needs in terms of lifestyle, nutrition, detoxification, physiotherapy, psychotherapy, and medical care. Therefore, live cell therapy is an individualized form of treatment. (1960 by Niehans; 1983 by Schmid)

For the past 30 years, it has been possible to safely manufacture stem cell xenotransplants of any of the 220 or more types of human stem cells and to implant them without immunosuppression using "state of the art primary tissue culture." (Molnar 2006; Abdul Halim 2017). In the 1960s, the first human-based stem cell transplantations took place. Embryonic stem cells, bone marrow stem cells, induced pluripotent stem cells (iPSCs), and mesenchymal stem cells are all examples of human-derived cells that have been used extensively in current medical research and clinical studies.

The first human hematopoietic stem cells (HSCs) were discovered in 1908, but it wasn't until the self-renewing cells in bone marrow were reported in the 1960s that bone marrow transplantation as a treatment for hematological malignancies and immunological deficiencies was developed.

However, there are considerable immunological obstacles that must be overcome for allogeneic hemopoietic stem cell transplantation in humans. To increase the number of HSCs available for therapy and to safely develop the ability to reprogram faulty HSCs for targeted therapy, it is also necessary to create reliable ways for maintaining HSCs in vitro. (Simpson and Dazzi, 2019; Ng and Alexander, 2017)

## Stem cell biology

Age-specific stem cells can be categorized into three main categories: fetal stem cells (depending on the time of harvest), adult fetal stem cells, and embryonic stem cells (from fertilization through the eighth week of gestation). Adult and embryonic stem cells of human origin have received the majority of attention in contemporary research. Animal-derived fetal stem cells, which have been used by clinicians for more than a century, are seldom ever discussed.

The embryo's blastocyst is the source of embryonic stem cells. Since it is pluripotent it can develop into any of the three germ layers—the ectoderm, the mesoderm, or the endoderm—and produce almost all any types of cell. Totipotent stem cells can differentiate into any type of body cell including the extra-embryonic cells (the placenta) thereby can form the whole organism.. Pluripotent stem cells can differentiate only into any of the three germ layers of the embryo. This is the primary distinction between totipotent and pluripotent stem cells. Rarely found in adult tissues, fetal tissues include partially differentiated fetal precursor (progenitor) stem cells. These fetal precursor stem cells are destined to give rise to specialized cells of the tissues of the corresponding organ, as opposed to embryonic stem cells which can potentially give rise to all types of the stem which develop from any of the three germ layers from which all the cells of the body develop (Hima Bindu et al., 2011)

Human embryonic and adult stem cells have limits. Teratogenicity and ethical concerns of embryonic stem cells are still open questions. Cell therapists have always maintained that embryonic stem cells are carcinogenic and should not be utilized for treatment (see review by Piscaglia et al., 2008). Human adult stem cells are as old as the individual and are ineffective. Immunosuppression is necessary. Allogeneic stem cells are immunogenic and implantation will require the use of immunosuppression.

This moral dilemma of embryonic stem cells is avoided by Yamanaka's work which creates induced pluripotent stem cells (iPSCs) from intact differentiated somatic cells like skin cells. The production of cardiac, muscular, neural, and other stem cell types for regeneration has been

the subject of extensive genetic engineering research. While autologous iPSCs may reduce the need for immunosuppression, research is still being done on safe and effective treatment procedures for many illnesses that are now untreatable by conventional therapy (Takahashi, et al., 2007; Mummery, et al., 2012; Singh, et al. 2015).

The worldwide shortage of compatible human organs (such as kidneys, livers, hearts, and pancreas) has spurred efforts to obtain organs from animals but rejection is a problem in organ xenotransplantation.

In actuality, cell therapy involves employing fetal stem cell xeno-transplants of any kind as needed by patients, with safety and efficacy data gained decades ago and a wealth of published clinical experience accumulated. Just using the corresponding precursor stem cells of animal origin to treat patients would be so much simpler.

### **Animal derived stem cells**

Experienced practitioners of cell transplantation recognized decades ago that in cell therapy transplants of various organs or tissues contain all generations of the family of a certain cell type, including those of the fetal precursor cells. These have been used to treat millions of patients and are still being used in certain parts of the world under the name of fresh cell therapy. Cell therapy has been hailed as the safest form of biotherapy since the 1980s provided the animal source has been kept under strict veterinary surveillance (Niehans, 1960; Schmid, 1983)

In this article, the term "live cell therapy" refers to the implantation of fetal precursor stem cells from primary tissue cultures obtained from live tissue fragments/clusters of various organs and tissues, of animal origin (xenogeneic), to treat diseases in humans. Since the early 1900s tissues from fetuses and animals under close veterinary surveillance have been used for treatment by cell therapists who follow Niehan's "Cell Therapy" methodology for more than a century. To acquire the fetal cells, the mother is sacrificed and dissected. Organ tissues are removed, put in a sterile Ringer solution, and then quickly cut into tiny pieces. Cell

suspensions are injected intramuscularly as soon as feasible. (Niehans, 1960; Schmid, 1983)

Fetal precursor xeno stem cells have been created over the past 30 years using cutting-edge "primary tissue cultivation techniques" under FDA USA guidelines. The focus of this paper's discussion will be animal-derived fetal precursor stem cells prepared using this process.

### **Fetal precursor stem cell xenotransplantation**

It is safe and recommended to use precursor stem cell xenotransplants to treat failing organs before they progress to the point of end-organ failure. Unlike human embryonic stem cells, it does not have any moral, ethical, or religious issues.

The mechanism of homing (the Halsted Principle) is one of the primary topics in stem cell xenotransplantation. There appears to be a direct correlation between the degree of organ malfunction and the number of transplanted cells required for the condition's effective treatment, according to this theory, which asserts that implanted stem cells migrate to the site of need, i.e. injured organs or tissue (Schmid, 1983; Molnar, 2006; Zanjani, et al., 1993)

The homing principle, which has been understood in classical cell therapy since 1908, is now widely acknowledged in cell biology. The "signal theory" was developed by Gunter Blobel, Physiology and Medicine's 1999 Nobel Prize winner. He was credited with discovering "signal peptides," which function as "address peptide tags" to guide peptides and protein molecules to the correct site. By merging traditional cell biological methodologies with molecular biology and biochemistry, he was able to successfully validate every part of his signal theory. It is now widely accepted that the signal theory characterises cell biology. (Blobel, 2018; Frenette et al., 1998; Quesenberry, 1998; Whetton and Graham, 2022; Ratajczak and Abdelbaset-Ismail, 2016; Academic Press, 2016; Lapidot and Dar, 2005; Chute, 2006; Liesveld. et al., 2020; Li. et al, 2018). Blobel was credited with "ushering cell biology into the molecular age."

Cell therapy's fundamental tenet is that the homing principle is actually organospecificity.

Research demonstrating the organ-specific effects of cell transplants from the liver, heart, adrenal glands, lacrimal glands, skin, thymus, and islets of pancreas was published in the 1950s and 1960s. Although they were only ever present in homologous organs, these effects were irrespective of the species used. However, a large portion of the published study was only available in non-Anglophone literature (Schmid and Stein, 1967; Schmid, 1983).

Before the 1930s, Niehan had been transplanting the anterior lobe of the pituitary from calf to people who had psychosocial short stature. In 1931 he was consulted by a renowned Swiss surgeon Prof. Fritz de Quervain to treat a woman dying of tetany after having all of her parathyroid glands accidentally removed during a total thyroidectomy operation. To his great astonishment, the tetany instantly subsided after he injected a chopped up parathyroid gland tissue with a syringe and needle. This well documented and widely reported incident practically led to the invention of live cell treatment, and it was officially approved as a therapeutic tool of the medical community in Switzerland in 1931 without any prior research or intellectual debates. The patient made a full recovery and was tetany-free for more than 25 years without hormonal treatment. In reality Niehans had treated more VIPs of our world during his lifetime than any other physicians and all were done without the use of immunosuppression (Niehans, 1960; Abdul Halim, 2017).

In fresh cell therapy, the fetal stem cell suspension was implanted shortly after resection. The introduction of germs cannot be ruled out despite thorough initial inspection and strict asepsis compliance. Fresh cell therapy, in contrast, to live cell therapy today, has never employed animals from a closed colony. Fresh cell therapy is now largely of historical significance. "The state-of-the-art primary tissue cultures" have been used for the past 30 years to prepare fetal precursor stem cell xenotransplants. ALL THESE CELLS ARE DERIVED FROM TISSUE FRAGMENTS AND NOT CELL LINES. During the culture process, the fetal cells' quality can be seen. There is ample time for the careful inspection to make sure the cultures are free of any disease. Controlling asepsis is simpler. These fetal xeno

stem cells manufactured from primary tissue cultures were discovered to be significantly less immunogenic, making them safer. Nearly full immunological tolerance is reached (Molnar, 2006).

Historically, cell therapists have never promoted the use of embryonic stem cells. It is known that these cells are teratogenic (Piscaglia et al., 2008). In reality, cell therapists think that cell lines are ineffective for regenerative therapy and never use them. The direct stimulation of regeneration is thought to account for 70% of the benefits of fetal precursor stem cell transplantation, with the remaining 30% regenerative effect on the corresponding organ cells themselves (autocrine effect). This can be investigated further. It is fascinating to consider that the therapeutic effects of fetal precursor xenostem cells may result from both the autocrine and paracrine effects of the donor stem cells. to stimulate regeneration and repair in the recipient.

The world's medical literature states that no viral disease has ever been known to be transmitted from rabbits to humans; hence rabbits are chosen as sources of fetal stem cells. The World Health Organization, which is in charge of overseeing vaccine production globally, has confirmed this. The WHO keeps a tight eye on the health of laboratory rabbits since vaccines are made using cell cultures, with rabbit kidney cells being one of the most crucial (Molnar, 2006)

Each stem cell transplant is meticulously prepared by a tissue culture specialist under the main tenets of the US FDA Regulation of 1/19/2001. The link between the sample and the recipient patient must be traceable at any moment if requested in the future. Each transplant sample must be kept in liquid nitrogen for five years. There is no genetic engineering involved in the preparation of these fetal precursor stem cells (Molnar, 2006)

How stem cell xenotransplants have been used with "state-of-the-art safety" for more than a century instead of stem cell allotransplants is supported by well-established scientific facts (Molnar, 2006). All eukaryotic cells in nature are built and function according to the same laws. Regardless of the species of origin, the

corresponding cells of the identical organ of different animal species (including man) are biologically similar. This is the "Principle of organospecificity" described in German and Soviet/Russian literature since the early 20th century. Paracelsus in reality has described this in his book in the 15th century "Hearts heal hearts, kidneys heal kidneys" and "Like heals Like" (see review by Eknoyan, 1996). All biological systems in nature originate from a common ancestry and are composed of almost the same types of molecules. In general, they carry out similar functions. This is referred to as a 'Principle of Homology'. Human and animal embryonic cells placed side by side look alike. Human and animal precursor stem cells of the same type also look alike and most of the available cell-surface markers are the same. The only way to tell the difference is by their karyotype

Live cell therapy uses tissue clusters/fragments of fetuses. Embryonic stem cells or adult cells are not used. Fetal precursor stem cells have many advantages over adult stem cells, as given below:

Description	Fetus	Adult
Therapeutic potential	High	Low
Differentiation	Fast	Slow
Adaptability	High	Low
Cell division	Fast	Slow
Immunogenicity	Practically nil	Higher
Survival time	Higher	Lower
Quantity	Numerous	Less
Homing efficiency	High	Less

Fetal precursor stem cells are no longer pluripotent and are committed to a predetermined path of along one lineage only ie as from where they originate. They retain their capability of long term self-renewal. Derived from tissue fragments these cells live in a milieu of various specialized (differentiated) cells with a lot of interaction between them, unlike undifferentiated cells which are grown in tissue cultures. Preparation of fetal precursor cell xenotransplants for live cell therapy have always been based on primary tissue cultures of cell

fragments and not on dispersed cells which have lost the cell to cell communication via soluble factors and their electromagnetic fields. Unlike cell lines from dispersed cells, cells that are cultured from tissue fragments maintain their diploid set of chromosomes, typical of the normal somatic cells of the animal sources of tissue culture and do not differ structurally or biochemically. Cell therapists believe that precursor stem cells grown from primary tissue cultures are even less immunogenic and safer than fresh cells employed by cell therapists in the past (Molnar, 2006).

Cell therapists believe that adult stem cells have a lower therapeutic potential but their therapeutic potency can be enhanced by co-culture with precursor stem cells of the same organ or tissue of animal fetal origin. Immunosuppression is still necessary for the implantation of adult stem cells due to their immunogenicity (Yawen Chen et al. 2020)

### Prevention of zoonoses

Rabbit is the chosen animal for live cell transplant which we derived the stem cells from. The rabbit fetus at least a maximum 5 days before birth is the best condition to collect the stem cells freshly before xenotransplants. Rabbit cells have been selected as closed colonies for the treatment based on the characteristic of the cells. The cells are abundant and allowable to be consumed by any religions in the world. Dissection of fetal and newborn rabbits is technically easier as compared with larger animals. There is a low risk/benefit ratio because of the lack of transmission of any infection by stem cell transplantation with fetal and newborn rabbits as the source. The common knowledge in veterinary and human medicine that none of the known viral diseases are transmissible to man. Endogenous rabbit retroviruses have not been recognized. Even if they are found, the scientific fact is that they are unlikely to be infectious to humans.

### Preparation of fetal precursor xenotransplants

Fetal precursor xenotransplant preparation must adhere to the rules and guidelines of the FDA USA. This includes the handling of closed colony animals (such as sheep, rabbits, and others), the preparation of fetal stem cells, the screening for pathogens (such as bacteria,

endotoxins, and fungi), and the preservation of tissue samples for at least five years in case they need to be tested for xenosis by an independent laboratory.

The laboratory activities will be performed in a closed colony under strict supervision of environmental conditions. By doing this, the health of the rabbits will be guaranteed. Anyhow, each laboratory using closed colony animals must adhere to the 3Rs component. To prevent stress and undesired behaviour in the rabbits, elements of reduce, refine, and replace should be considered. Only one rabbit will occupy a cage, with the exception when it is time for mating. Alfalfa leaves are provided to the rabbits instead of pellets to simulate their natural environment, where they constantly chew to keep their teeth sharp. Following the FDA USA is crucial when using the 3Rs to raise rabbits in confined colonies for live cell treatment.

### **The protocol of Live Cell Therapy**

For decades, physicians have used live cell therapy in two different circumstances. First, in a situation where there is no known treatment in conventional medicine. This category encompasses nearly all genetic and chromosomal problems as well as neurodegenerative diseases. Second, when the disease can no longer be controlled by the usual treatment. Diabetes mellitus and its consequences are a good example. Live cell therapy should be considered for diabetic complications such as nephropathy, retinopathy, polyneuropathy, and lower extremity arterial disease where conventional treatment is no longer able to stop the progression.

Live cell therapy is a unique therapeutic procedure in that the stem cell prescription is custom-made for the patient to be used at a pre-determined date of implantation. The treatment protocol is an individualized and integrative form of treatment. The clinician functions as a pathophysiologist to arrive at a pathophysiological diagnosis by which all the dysfunctioning organ systems are determined and the stem cell prescription was prepared accordingly. Cell therapy has been described as a safe form of biotherapy provided the cells are properly prepared. There are no serious risks and adverse reactions from the implantation to

be expected. To prevent non-compliance and wastage of this precious biological material, a pre-payment policy for the production costs of all precursor stem cell xenotransplants is required. When these stem cells are not implanted on the scheduled date they will have to be discarded (Molnar, 2006; Abdul Halim, 2017)

Stem cell transplantation is vastly different from drug and/or hormone therapy. In the case of hypofunction of endocrine organs such as the thyroid, and adrenals, cell therapy with corresponding endocrine organ cells does not lead to atrophy of these glands, unlike hormonal therapy. Cell therapy is a powerful hormonal balancer. It is a powerful immunostimulant with the appropriate combination of cells which may include cytotrophoblast, mesenteric lymph nodes, thymus, spleen, liver, and intestine.

### **Clinical Treatment by Live Cell Therapy (Fetal Precursor Stem Cell Xenotransplantation)**

Standard medical textbooks state that there is no treatment for genetic and chromosomal disorders with rare exceptions. In reality, there have been publications from university hospitals in Germany, the USSR/Russia, Spain, and the USA on the treatment of Down syndrome and other genetic and chromosomal abnormalities by a complex therapeutic protocol based on stem cell xenotransplantation since the early 1900s. (Schmid 1983; Molnar, 2006). Treatment of Down syndrome aims at eliminating or minimizing the ever-increasing delay in brain development with age, and this has been replicated. The author maintains that live cell therapy for Down syndrome is one of the most convincing and satisfactory fields of pediatrics (Abdul Halim, 2017).

Diabetes mellitus Type I and II with complications of nephropathy, polyneuropathy, retinopathy peripheral arterial disease, Duchenne muscular dystrophy, cardiomyopathy with ischemic heart disease, heart failure, liver failure, pancreatic insufficiency, kidney failure, chronic lung disease-bronchiectasis with recurrent pneumothoraces and also eye diseases (macular degeneration) are among potentially treatable conditions with live cell therapy.

Other cases treated with good clinical outcomes include cerebral palsy with visual defects, epilepsy, autism, cancer of the lung and breast after chemotherapy and radiotherapy for immune stimulation, neurodegenerative disorders like Parkinson's disease, Alzheimer's disease, multiple sclerosis, autoimmune disorders such as rheumatoid arthritis, SLE, AIDS, general revitalization, premature menopause, infertility, and other genetic and chromosomal abnormalities untreatable in conventional medicine (Kahnau, 1983; Molnar, 2006).

Pregnancy, breastfeeding, acute viral and bacterial infections, patients with disseminated septic foci, patients who are moribund, and patients with active malignancy that have not been resolved are all contraindications and precautions for fetal stem cell therapy. Myocardial infarction, pulmonary edema, hypertensive emergencies, acute strokes, acute bleeding, and coagulation problems are medical emergencies that should not be treated (Molnar, 2006).

Human-derived stem cells have enormous promise for use in transplantology and regenerative medicine. The use of a patient's cells without immunosuppression is possible through induced pluripotency. The use of human-derived stem cells as safe and effective therapeutic regimens for diseases like cancer, diabetes mellitus, organ failure, and neurodegenerative diseases is still being studied.

Several encouraging results for cell treatment employing primary tissue cultures and fresh cells from rabbit fetuses have been published (Abdul Halim, 2017). It is possible to obtain all the 220-250 different types of precursor stem cells needed for regenerative medicine in unlimited quantities and without the use of genetic engineering. Immunosuppression counteracts the therapeutic effects of the fetal precursor stem cells. Avoidance of immunosuppression in live cell therapy is of crucial importance for the patient in clinical practice and may be the reason for the safety and effectiveness of the treatment modality.

## **Cell Culture Technique for Live Cell Therapy**

### ***Cell derivation***

The fetal rabbit is dissected and its organs are obtained for cell derivation afterward. The organs are washed with the complete media (DMEM + FBS + Antibiotic). Then, the tissue is cut and minced in the Accutase, one type of proteolytic and collagenolytic enzymes. After the tissue of the organ is minced thoroughly, it is kept in the 15 ml conical tube that has been filled with Accutase for about 15 minutes. After 15 minutes pass the complete media is added into the 15 ml conical tube filled with minced tissue and Accutase. The tube is then centrifuged at 1000 rpm for 3 minutes. The supernatant is discarded carefully without interfering with the pellet at the bottom of the conical tube. Then, the pellet is resuspended with the complete media and the suspension is transferred into the 12-well culture plate. The culture plate is then incubated inside the CO<sub>2</sub> incubator at 37°C and 5% of CO<sub>2</sub>. (Mazlan, Isa and Ibrahim, 2020; Jenuit et al., 2021)

### ***Cell culture and passaging***

The cells that are derived are maintained with routinely supplied fresh complete media as their nourishment. Once the cells achieved above 70% of confluency, they are passaged to the bigger culture plate and flask. The process of passaging involves the introduction of Accutase to the cells for about 5 minutes. After the cells are detached from the plate or flask, they are transferred into a 15 ml conical flask filled with complete media. Then, the mixture is centrifuged at 1000 rpm for 3 minutes. The supernatant is discarded and the pellet is resuspended into the bigger cell culture plate or flask with complete media, (Mazlan, Isa and Ibrahim, 2020; Jenuit et al., 2021).

### ***Preparing for the cell live therapy prescription***

The cells in the T75 culture flask are detached with Accutase and neutralized with complete media. The mixture is then centrifuged at 1000 rpm for about 3 minutes. The supernatant is discarded and the pellet is resuspended with complete media. Then, the suspension is transferred into the 5 ml tubes that had been exposed to ultraviolet light. The tubes are then

sealed with parafilm to reduce the risk of contamination and to avoid any spills during transportation (Mazlan, Isa and Ibrahim, 2020; Jenuit et al., 2021).

### **Safety studies**

Cell therapy has been described as a safe form of biotherapy. In our own experience of more than 16 years on transplantation, we had less than 5 % of cases implanted requiring treatment for minor side effects like fever, skin rash, and one toddler requiring observation in hospital for a probable adverse effect of lidocaine (no longer used nowadays with implantation) and swellings at implantation sites which settled after a few days. There have been no reports of clinical chimeras, xenogeneic infections, or fatalities following our fetal stem xenostem cell transplantation (Niehans 1960; Schmid 1983; Molnar 2006). Clinical research conducted in Malaysia has also demonstrated the safety of this treatment modality.

### **Future studies**

Over the past century, it is believed that between 5 and 25 million people have undergone stem cell transplantation, with 99% of those procedures being xenotransplantation. These are usually carried out without immunosuppression. From the published works it appears that this form of treatment is far better founded theoretically and experimentally than many forms of therapy. The assertion that it lacks scientific significance can be explained by the absence of experience and knowledge of the literature.

More evidence of positive outcomes achieved through the use of live cell therapy is required to advance. Because this is a form of surgical treatment, randomized control trial studies are not very useful. Being an individualized therapy, it is impossible to provide a clear answer to queries about the number of fetal stem cells implanted, the number of tissues used, the spacing between implantations, or adherence to the pre-and post-transplantation protocol. Drugs such as steroids, antibiotics, anticonvulsants, cancer chemotherapy, and electromagnetic wave radiation all destroy structures and will counteract the constructive principles of live cell therapy. Live cell therapy is vastly different from drug therapy. The effect is more pervasive. The

speed and duration of treatment vary from patient to patient.

Understanding the biology of these cells will require more in-depth study using genomics, proteomics, metabolomics, and other biomarkers and research tools. On the clinical applications, the challenge is to formulate acceptable clinical research designs that take the whole-person approach to treatment into account. Further research will enable a clearer definition of live cell therapy in the field of regenerative medicine and transplantology.

### **Epilogue**

In some parts of the world, doctors are still using cell therapy to treat disorders that cannot or have failed to be treated with the conventional form of medical treatment. In comparison to older fresh cells or frozen cells, "state-of-the-art primary tissue cultures" used to create fetal precursor stem cell xenotransplants from closed colony animals have an even greater safety profile.

Many of the many groundbreaking studies of physicians and scientists on cell therapy in the early 1900s have been published in non-Anglophone media and it is not surprising that many conventionally trained physicians are not familiar with or ignorant of this modality of treatment.

Human organ allo-transplants usually result in graft rejection. Hence immunosuppression is required for the rest of their lives. The shortage of compatible human organs for transplantation has spurred the search for stem cells of human organs for the treatment of diseases. The potential of human-derived stem cells for regenerative medicine is immense, especially because of induced pluripotency which will enable patients' stem cells to be used without immunosuppression. However safe and effective treatment protocols for diseases such as neurodegenerative diseases, complications of diabetes mellitus, organ failures, aging diseases, and cancers with the use of different types of human-derived stem cells are still very much in the research stages. A therapeutic option that is safe and potentially effective for the treatment of various currently untreatable medical conditions is live cell therapy.



## Conclusion

Live cell therapy is safe and potentially effective for the treatment of various currently untreatable medical conditions. Fetal precursor stem cell xenotransplants from closed colony animals have greater safety profile. Groundbreaking studies on cell therapy have been published in non-Anglophone media consequently many workers are not aware of this modality. The potential of human-derived stem cells for regenerative medicine is immense. Induced pluripotency will enable patients' stem cells to be used without immunosuppression. Safe and effective treatment protocols for neurodegenerative diseases, complications of diabetes mellitus, organ failures, aging diseases, and cancers with different types of human-derived stem cells are in the research stages.

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