

Human-to-Human Solid Organs' Transplantation: A Fascinating Tale of Creativity and Determination

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ABSTRACT

The term "human- to- human organ transplant" typically refers to transplants of the solid organs through a surgical procedure in which a failing or damaged organ in the human body is replaced with a healthy one, from another human. The solid organs that have been successfully transplanted, so far, include kidneys, lungs, pancreas, liver and heart, in chronological order. Whereas all of them are equally important, from a physiological point of view, the transplantation of heart has been given projection second to none, both from the cardiovascular community and the general public. This raises interesting questions: why so? What incredible wonder is the human heart? In which way heart transplant is more important than those of other solid organs? The believable explanation is that the heart, in addition to its own function as a vital organ, has psychological, moral and spiritual functions. In fact, it is "*a holistic-comprehensive structure in which all human faculties are unified and integrated*". In addition to well documented psychological, psychosocial and medical consequences of heart transplantation, there is a good bank of knowledge regarding changes in the personal characteristics of the post-transplant persons.

Keywords: Solid Organs' Transplant, Heart Transplant, Post-Transplant Changes.

WHAT IS NEW/IMPORTANT?

Amongst the transplantations of solid organs, that of heart has been given projection, second to none. The believable explanation is that the heart, in addition to its own function as a vital organ, has psychological, moral and spiritual functions.

INTRODUCTION

"In fact, basic scientists were pessimistic about the feasibility of human transplantation. For example, in his book "The Biological Basis of Individuality", Dr.Leo Loeb categorically stated that transplantation between individual humans would never be possible. Although his thesis was accepted as dogma by some, it did not seem irrefutable to me. Surgeons, by nature, tend to be optimists".

Vol No: 08, Issue: 05

Received Date: November 13, 2023

Published Date: December 28, 2023

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Citation: Khan IA. (2023). Human-to-Human Solid Organs' Transplantation: A Fascinating Tale of Creativity and Determination. Mathews J Emergency Med. 8(5):67.

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Dr. Joseph Edward Murray (1919-2012) - Pioneering Plastic Surgeon and Father of the First Organ Transplant.

A human-to-human organ transplant is a surgical procedure in which a failing or damaged organ in the human body is replaced with a healthy one from another human. The term “solid organ transplant” typically refers to transplants of the solid organs: kidneys, lungs, pancreas, liver and heart. Successful human to human solid organ transplantation, during the past 70 years, is one of the most remarkable and dramatic therapeutic advances in the medical field. It has transformed the survival and quality of life of those with end-organ dysfunction, offering life-saving treatment for terminal diseases.

Prior to the 1900s, human organ transplantation was judged to be impossible. But Dr. Joseph Edward Murray, with his groundbreaking surgical feat and unwavering optimism, opened a new era of medicine. In 1954, he successfully performed renal transplantation, first in identical twins, then in non-identical twins and, finally, using a cadaveric donor [1]. It was not success of an individual or a group of dedicated researchers. In fact, *“it is the gift of life to hundreds of thousands of people destined to die young”*. It was materialization of the dream of Hippocrates (460 BC- c 370 BC), Father of Medicine as Rational Science: *“Wherever the art of Medicine is loved, there is also a love of Humanity.”*

The present study is aimed at appraising the readers of academic history of solid organs transplantation. Guidelines of Hamilton College for “Writing a Good History Paper” were followed. Library immersion, analysis of archives and web search were the mainstay of the sources. The written primary sources of information were letters, diaries, memories, speeches, church records and newspaper articles. The secondary sources included scholarly write-ups of “disinterested observers” who were, by any means, connected to the series of events; and also, the unbiased historians [2].

“Spare Parts Surgery” or “Borrowing Life”

“The human body is the only machine for which there are no spare parts”.

Hermann Michael Biggs (1859–1923) American physician.

The above statement by the Pioneer in the field of Public Health is no longer tenable. The success of spare part surgery has revolutionized the clinical management of otherwise incurable maladies.

The concept of transferring body parts has a long and

venerable history in ancient Roman, Greek, Indian, Chinese, and Egyptian legends. The first written record of transplant is attributed to the Ebers Papyrus (circa 1550 BC) which mentions skin grafting for the treatment of burns [3]. Limb transplantation (replacing the cancerous leg of a Roman deacon with that of a recently deceased Ethiopian man) was first mentioned in literature in 348 AD [4].

The long-continuing and untiring efforts of renowned surgeons resulted in the first successful human to human kidney transplant in 1954, turning the folk tales of transplantation into a reality. The kidney was the first organ to be successfully transplanted, in 1954, followed by lung transplant in 1963, a simultaneous kidney and pancreas transplant in 1966, a liver transplant in 1967, heart transplant in 1967 and intestinal transplant in 1988. Intestine transplantation may be performed in isolation, with liver transplant, or as part of a multi-visceral transplant including any combination of liver, stomach, pancreas, and/or colon.

On December 23, 1954, at Peter Bent Brigham Hospital in Boston, Massachusetts, Dr. Joseph Edward Murray performed the first successful human kidney transplant on 22-year-old Richard Herrick suffering from chronic nephritis, a then life-threatening diagnosis with no known cure. The live donor (Ronald) was a healthy twin brother. Richard had a pleasant family life and lived with his brother’s kidney for 8 years [5].

In 1959, the first kidney transplant in Louisiana State was performed at Charity Hospital in New Orleans. This case marked the first successful kidney transplant between individuals not genetically identical. This transplant was a brother-to-brother, living-related, fraternal twin transplant. The recipient had smooth active life for next 25 years and died of cardiac issues [6]. In April 1962, Dr. Murray performed a cadaveric kidney transplant. The recipient surviving over one year was the world’s first successful unrelated renal allograft [7].

On June 11, 1963, left lung transplantation was performed, at the University of Mississippi Hospital, successfully by James Hardy and his team on 58-year-old John Richard Russell (later identified as a convicted murderer) with left lung bronchial carcinoma. The patient survived 18 days and died of renal failure and infection. The lung, at autopsy, was well ventilated and there was no evidence of rejection [8].

On July 27, 1967, Dr. Thomas Starzl performed the first successful liver transplantation, at the University of Colorado University Hospital, on a 19-month-old girl named Bennie

Solis with hepatocellular carcinoma. She survived 13 months before dying of metastatic disease [9].

On December 3, 1967, the first successful heart transplant was carried out by Prof. Christiaan Barnard in Cape Town, South Africa, on Louis Washkansky 53 years. The recipient lived for 18 days. The cause of death was pneumonia and septicemia [10].

Dr. Fritz Derom performed single-lung transplantation at the University Hospital in Ghent, Belgium on November 14, 1968 on Aloïs Vereecken who became the first mid-term (10.5 months) survivor at the time [11].

The first heart-lung transplantation was performed in Houston by Denton Arthur Cooley, in 1968. The girl who received this transplant survived only for 14 hours [12]. The first long-term survival was achieved when Dr. Bruce Reitz and Dr. Norman Shumway performed the first successful heart-lung transplant at Stanford Hospital on March 9, 1981. The patient was a 45-year-old newspaper executive named Mary Gohlke, suffering from primary pulmonary hypertension. When she died five years later, she did not have any findings of chronic rejection in either her lungs or heart [13].

Heart Transplant: "The Surgical Equivalent of the Ascent of Everest"

"The credit belongs to the man who is actually in the arena.....who knows the great enthusiasms, the great devotions; who spends himself in a worthy cause; who, at the best, knows in the end the triumph of high achievement".

Theodore Roosevelt (1858-1919) -26th President of United States.

The evening and early morning of 2nd and 3rd December 1967 were groundbreaking moments in the history of medicine when Prof. Christiaan Neethling Barnard, leading a large medical and para-medical team, dared to perform the world's first human to human heart transplant at Groote Schuur Hospital in Cape Town, South Africa. Within two to three weeks, the global media concentrated on Barnard and his marvelous achievement resulting in his appearance on the front covers of numerous magazines, notably Time, Life, and Newsweek. The level of esteem in the eyes of the medical community and general public, Barnard got, was unimaginable. The Time magazine perceived it as "The Surgical Equivalent of the Ascent of Everest" [14].

The story of this 45 years old courageous surgeon is similar to that of renowned Persian physician Ibn Sina (980-1037)

who once wished *"I prefer a short life with width, to a narrow one with length"*. God Almighty was gracious enough to hear to his submission and raised him to the level of "one of the most famous of all races, places and times", "Father of Early Modern Medicine", "Father of Clinical Pharmacology" and sole author of "The First Textbook of Medicine on Earth", in a total age of only 57 years [15]. Filled with veneration for Prof. Barnard and recognition of the iconic event, the medical community organized a high-profile event titled: "50 Years of Heart Transplantation: Courage and Innovation", at Groote Schuur Hospital, Cape Town, South Africa, 2-4 December 2017. It was a humble tribute to the "Man of Hour" [16].

The Donor of the First Successful Heart Transplant

"It is infinitely better to transplant a heart than to bury it to be devoured by worms".

Prof. Christiaan Barnard (1922-2001).

Denise Ann Darvall (1942-1967), a young white girl, on December 2, 1967 at around 15:30, met a serious roadside accident, at Cape Town, resulting in massive head injury. From the accident scene she was hurriedly rushed to Groote Schuur Hospital where, despite all possible resuscitation, she succumbed to the lethal trauma. Denise was declared brain dead by 9 pm, which was the first indication of her becoming a viable donor [17]. Approached and convinced by Prof. Christiaan Barnard, Denise's father, Edward Darvall had to make a very difficult decision. The grieved father quickly gave his consent to remove her heart for transplanting to the patient dire in need of. Edward had been quoted as saying: *"If you cannot save my daughter, you must try and save this man"* [18].

Consequently, her heart was removed by the cardiologist Dr. Marius Barnard, the brother of the lead surgeon Prof. Barnard. Denise's heart was used for the first heart transplant that was successful in the world. Her kidney was also removed and donated to the 10-year-old Jonathan van Wyk of Blackheath Cape Town. Her death, though painful, resulted in saving countless others [19].

The Old Man with the Heart of a Young Girl

"The tragic death of my daughter was not meaningless but benefited humanity".

Edward Darvall (Donor's Father).

In addition to Prof. Barnard, Groote Schuur Hospital, Cape Town, South Africa, and Louis Washkansky became world renown overnight as the breaking news was made public. At 1:17 pm on December 3, 1967, AFP's telex machines rattle

out a short piece, originally in French: *“A heart transplant, believed to be the first in the world, was successfully carried out today at Groote Schuur Hospital in Cape Town”* [20]. From today’s standard of fitness for any surgical procedure, Washkansky 53 years, a case of heart failure, was far from being acceptable. He was a diabetic and a smoker with peripheral vascular disease. Furthermore, he had massive dependent edema with infected ulcers. Bernard had shown immense courage in planning a new heart for him. While in ICU, the patient’s progress was covered by the world’s media, on an almost hourly basis. “Transplanted heart beating “was the headline of quite many newspapers.

About 33 hours after the operation, in his first conversation the patient said, “I am much better.” About the surgeon he remarked “the man with the golden hands”. Barnard said, “I gave you a new heart”. Four days later, Washkansky said to a visiting French doctor: “Tell the Parisians to make a collection and buy me a plane ticket and I will come over and see them”. [21]. Washkansky’s daily progress was followed intensely not only in the hospital but also in the medical community around the world. The early post-op recovery continuing for two weeks was excellent. Later on, his condition started deteriorating and he unfortunately succumbed from severe pneumonia and septicemia on the 18th day postoperatively.

Post-transplant Longevity and Quality of Life

“You can change your life by changing your heart”.

Max Lucado (1955)—American Author.

Although the first heart transplant patient of Groote Schuur Hospital could survive only 18 days, the duration, with further advancement of technology and refinement of the procedure, reached up-to 23 years subsequently. Dirk van Zyl, the sixth transplant patient of Prof. Bernard, lived 23 years with new heart. The remarkable fact about Dirk is not only the longevity of survival but the excellent recovery from the transplant surgery. Within three months he returned to work and did not miss a single day’s duty for the next 15 years of his service. After retirement in 1986, he lived a happy life till his death on July 7, 1994, due to stroke [22].

John McCafferty had a heart transplant by surgeon Sir Magdi Yacoub at Harefield Hospital UK. He died on October 20, 1982, at the age of 73 years, 33 years after getting new heart. His widow Ann said: “The last 30 years we had together were brilliant. We had travelled the world.” The couple celebrated their 50th wedding anniversary in October. He was officially recognised as the world’s longest surviving heart transplant patient by Guinness World Records in 2013. At that time, he said: “I want this world record to be an inspiration to

anyone” [23].

Harold Sokyryka (born January 16, 1952) of Saskatoon (Canada) is officially the longest-surviving patient, for living 34 years and 359 days, after receiving his transplant, as verified on May 28, 2021. He has been given the Guinness World Records’ title. With advanced cardiomyopathy, he got the rare opportunity to get a second chance to live through the donated heart from a multiple organ donor Bruno Duguay (from Quebec, Canada) who died in a car accident. Bruno was one of the first multiple organ donors in Canada who saved six people’s lives, as his father was able to make the decision for organ donation [24].

Baby Moses is the name coined for the first infant born on November 16, 1985, with hypoplastic left heart syndrome. He received a successful infant-to-infant heart transplant. The baby is now Eddie Anguiano, the longest-surviving individual to receive a new heart as a newborn. The heart, donated by the family of an infant in the San Francisco Bay area, still pumps in his chest. On December 9, 2014, he, with his mother, had an informal reunion with Dr. Leonard L. Bailey chief of cardiothoracic surgery and pioneer in infant heart transplantation, Loma Linda University Children’s Hospital who had done the transplant. This was a very sentimental moment when the patient and his mother paid tribute to the surgeon who dared to care him 29 years ago [25].

DISCUSSION

“Man’s perceptions are not bounded by organs of perception; he perceives far more than sense (tho’ ever so acute) can discover”.

William Blake (1757-1827), Philosopher.

The solid organs that have been successfully transplanted, so far, include kidneys, lungs, pancreas, liver, and heart, in chronological order. Whereas all of them are equally important, from a physiological point of view, the transplantation of the heart has been given projection second to none, both from the cardiovascular community and the general public. As quite rightly remarked by Sliwa and Zilla, this was the “world’s most widely reported medical event ever, resulting in the celebrity status of a previously unknown physician” [26]. This raises interesting questions: why so? What incredible wonder is the human heart? In which way heart transplant is more important than those of other solid organs? The plausible answer is that the heart, in addition to its own function as vital organ, has psychological, moral, and spiritual functions, as mentioned in the next paragraphs.

It is well known that the heart is a blood pumping organ, the hardest working muscle in the body and the most vital organ where the life begins and comes into an end. But it is little known that it is much more than just a pulse generating organ. In fact, it is *“a holistic-comprehensive structure in which all human faculties are unified and integrated”* [27]. It has been believed to be the seat of intelligence, emotion and sensation in ancient scriptures and non-Abrahamic religions [28].

According to the three monotheistic religions (Judaism, Christianity, and Islam), it has psychological, moral and spiritual functions [29]. Amongst the over 60 emotions of the heart, enlisted by Midrash (an ancient commentary on the part of Hebrew Scriptures), the heart sees, hears, speaks, falls, stands, rejoices, weeps, comforts, sorrows. [30].

The heart, as “the site of both affective and cognitive activities” and organ of thinking and reasoning, makes moral judgments and issues authoritative commands [31]. However, it does not receive commands because it is the ruler of the body [32].

Mencius (circa 327-289 BC), the famous Confucian philosopher, distinguished the heart, the thinking organ, from the organs of ears and eyes, which do not think, and which tend to be deceived by external things when in contact with them [33].

The heart also manufactures and secretes oxytocin, which, in addition to its well-known functions in childbirth and lactation, acts as a neurotransmitter. Although it is referred to as “love or social-bonding hormone”, its role in cognition, tolerance, trust and friendship and the establishment of enduring pair-bonds has been well recognized. Of imp, the concentrations of oxytocin produced in the heart are in the same range as those produced in the hypothalamus and secreted into the blood stream by the posterior pituitary gland [34]. Hence with each beat, that the heart not only pumps blood but also continually transmits dynamic patterns of neurological, hormonal, pressure, and electromagnetic information to the brain and throughout the body [35].

In addition to well documented psychological, psychosocial and medical consequences of heart transplantation, there is a good bank of knowledge regarding changes in the personal characteristics of the post-transplant persons. American Neuropsychologist Prof. Paul Pearsall (1942-2007) in the published accounts of seventy-three heart transplant recipients has categorized such changes as:

- a. changes in preferences
- b. alterations in emotions/temperament
- c. modifications of identity
- d. memories from the donor’s life [36]

A few such cases are reproduced here for interest [37].

- I. An 18-year-old female, with pre-transplant diagnosis of endocarditis and subsequent heart failure, received heart from a 18 year-old-male fatally hit in a motor vehicle accident. The donor was a musician and a poetry writer. His parents, while cleaning his room a year after his death, found a song “Danny, My Heart is Yours”. When his pictures and poetic verses were shown to the recipient she exclaimed “I know he is in me and he is in love with me. How would he know my name is Danielle? And then, when they played me some of his music, I could finish the phrases of his songs. I could never play before, but after my transplant, I began to love music. I felt it in my heart. My heart had to play it. I told my mom I wanted to take guitar lessons; the same instrument Paul had played”. Her mother told that when she wrote her first song, she sang about her new heart. She said her lover had come to save her life
- II. Carter, the recipient, was a 7-month-old boy, with pre-transplant diagnosis of Tetralogy of Fallot. The donor was Jerry, a 16-month-old boy drowned in a bathtub. The donor’s mother (a physician) said “when Carter (at the age of five years) first saw me, he ran to me and pushed his nose against me again and again. It was just exactly what we did with Jerry.....He said the same baby-talk words that Jerry said.....”. The recipient’s mother reported “Carter is very, very shy, but he went to donor’s mother just like he used to run to me when he was a baby..... Jerry’s mom told me that Jerry had mild cerebral palsy mostly on his left side. Carter has stiffness and shaking on that side (only showed up after the transplant)When we went to church together, Carter had never met Jerry’s father. We came late and Jerry’s dad was sitting with a group of people in the middle of the congregation. Carter let go of my hand and ran right to that man. He climbed on his lap, hugged him and said “Daddy.” How could he have known him? Why did he call him dad? He never did things like that. He would never let go of my hand in church and never run to a stranger”.

- III. A 9-year-old male recipient, with pre-transplant diagnosis of myocarditis and septal defect, developed an aversion to water. He described the imaginary picture of the donor "She seems very sad. She is very afraid. I tell her it's okay, but she is very afraid. She says she wishes that parents wouldn't throw away their children. I don't know why she would say that". His mother explained, "Jimmy is now deathly afraid of the water. He loved it before. We live on a lake and he won't go out in the backyard. He keeps closing and locking the back door walls. He says he's afraid of the water and doesn't know why?" The 3-year-old female donor had died of drowning at her mother's boy-friend's house. They left her with a teenage babysitter who was on the phone when it happened.
- IV. The recipient was Ben, a 56-year-old male college professor diagnosed with atherosclerosis and ischemic heart disease while Carl, the donor, was a 34-year-old male police officer shot attempting to arrest a drug dealer. The recipient reported "A few weeks after I got my heart, I began to have dreams. I would see a flash of light right in my face and my face gets real, real hot and actually burn". The donor's wife made comments: "This is exactly how Carl died.....shot right in the face. The last thing he must have seen is a terrible flash."

It is obvious that none of other transplantable organs have such qualities. Antoine de Saint-Exupery (1900-1944), French Writer, has beautiful words to share:

"It is only with the heart that one can see rightly; what is essential and what is invisible to the eye".

Possible Mechanisms for Post-transplant Personality Changes

"The memory is what remains forever, what stays during our life (individual memory) and is preserved in the next generations (species memory)".

Marco Cirrillo [38].

The issue of inheriting the memory experiences and emotions of their deceased donors with resultant significant changes in the personality of heart recipients is fascinating.

Cellular Memory: The theory of cellular memories states that memories, as well as personality traits, are not only stored in the brain but may also be stored in organs such as the heart. Cellular memory has been suggested to explain the transfer of personal memories from donor to recipient

following heart transplantation [36,37]. The various types of cellular memory include **Epigenetic memory, RNA memory** and **Protein memory**. The other types of memory which, in addition, could contribute to the transfer of memories, from donor to recipient are:

Cardiac neurological memory: It is known that the heart has two distinct networks of nerves, one consisting of nerve cells within the heart (intracardiac nervous system), and the other made up of nerves originating outside the heart. Whereas both the networks have the potential to encode, store, and retrieve memories, only the nerves within the intracardiac nervous system are transplanted with the heart [36].

The intracardiac nervous system remodels itself after cardiac transplantation, a process known as neuroplasticity. Possibly, the stored memories (within the intracardiac nervous system) are transferred to the recipient at the time of transplantation. [39].

Energetic memory: Pearsall suggested that the personality changes following heart transplantation may result from changes in the energy of the heart. He equates energy with information, explaining: *"energy and information are the same thing. Everything that exists has energy, energy is full of information, and stored info-energy is what makes up cellular memories"* [37].

Descriptions from different cultures describe two types of information or knowledge, one located in the brain and the second centered in the heart. The ancient Greeks described these two types of knowledge as diakresis (i.e. rational or deductive knowledge), and gnosis (i.e. intuitive or spiritual knowledge). The source of the latter was attributed to the nous, an organ located in the region of the heart, which was also referred to as the "eye of the heart" [36].

One type of energy is electromagnetic energy and one source of electromagnetic energy is the heart. The heart generates its own electromagnetic field, which is the largest such field in the body, producing an amplitude 60 times greater than the amplitude of the brain's electromagnetic field [35]. The heart transplantation changes the recipient's electromagnetic field with resultant alterations in his personality via changes in preferences, emotions temperament, memory and identity.

CONCLUSION

"Sometimes our light goes out but is blown again into flame by an encounter with another human being. Each of us owes the deepest thanks to those who have rekindled this inner light".

Albert Schweitzer (1875-1965) - Nobel Laureate for his philosophy of "reverence for life" and tireless humanitarian work.

Solid organ transplantations may, justifiably, be considered a miracle of twentieth century medicine. It is the only practicable remedial measure for terminal and irreversible organ failure, by improving life expectancy, enhancing quality of life and reducing comorbidities.

On the gracious occasion of decorating Prof. Joseph Edward Murray with Nobel Prize 1990, The Nobel citation read: "*He has given the gift of life to hundreds of thousands of people destined to die young*" [40]. In his Nobel acceptance speech, Murray gave credit to men who preceded him and those who worked with him. He said, "*We all have been warmed by fires we did not build. We all have drunk from wells we did not dig.*" These are golden words. Those who have borrowed lives through the spare parts, donated by others, need to realize that behind their second chance to live happily, were kind, determined personalities committed to serve ailing community.

ACKNOWLEDGEMENT

The author expresses great appreciation to Dr. Murad Ahmad Khan (Vancouver BC) for his insightful suggestions and stimulating discussions throughout the conduct of this study.

CONFLICTS OF INTERESTS

The author declares that there are no conflicts of interest to disclose.

FUNDING

The author received no financial support, from any quarter, for the research, authorship, and/or publication of this paper.

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