

Swap and Domino Organ Transplantation Transgressing Socio - Cultural and Political Boundaries

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Abstract: This paper emphasizes the importance of swap transplants for living donor and recipient incompatible pairs. Swapping living donors for getting most compatible organs for the recipients has given hope to a number of donor recipient incompatible pairs across the world including India. Such donations ensure the recipients of living donor organs receive most compatible organs by swapping donors. This paper offers a glimpse of Indian scenario on swap transplantation. While challenging social, religious and political boundaries created by humans such swaps have united people and professionals across nations. This paper briefly describes Simple Living Donor Exchange Domino Transplant, Altruistic Donor Initiated Domino Transplant and Recipient Facilitated Domino Transplant. This paper enumerates the advantages of swap and domino transplant and describes briefly domino heart, domino liver and domino kidney transplantation. This paper deliberates on simultaneous and non-simultaneous domino kidney transplantation and persuades all states to adopt THOA amendments 2011 so that the benefit of swap transplantation reaches to all incompatible donor recipient pairs all over the country. This paper identifies some challenges for making swap or paired donation possible in all the states and union territories.

Keywords: Swap Transplant, Domino Transplant, Simple Living Donor Exchange Domino Transplantation, Altruistic Donor Initiated Domino Transplant, Recipient Facilitated Domino Transplant, Domino Liver Transplant, Domino Kidney Transplant, Domino Heart Transplant.

1. INTRODUCTION

There are a number of patients battling for life with end stage organ diseases like kidney, liver, heart etc. For some of these patients it is either a living donor or a deceased donor that could give them a second lease of life. Waiting for a deceased donor organ is not of much help as such donors are infrequently available. This state of affairs frequently arises in India owing to availability of very limited donation from brain stem dead donors. In a number of cases the patient has a willing near relative or known unrelated donor who intends to donate a kidney or a part of liver out of love and affection but in some of these cases donor's organ is found unsuitable with the ailing patient because of blood group mismatch or immunologic incompatibility. It is necessary that the blood and tissue type of a donor and recipient match. The possibility of mismatch exists with all types of living donors whether near or known unrelated. Sometimes the blood group or tissue type or both in combinations do not match with the recipient. In such cases the best possible option is to interchange or swap the donor recipient incompatible pairs for transplantation so that the two recipients receive healthy and more compatible organs by interchanging donor organs as shown in Fig.1 below:-

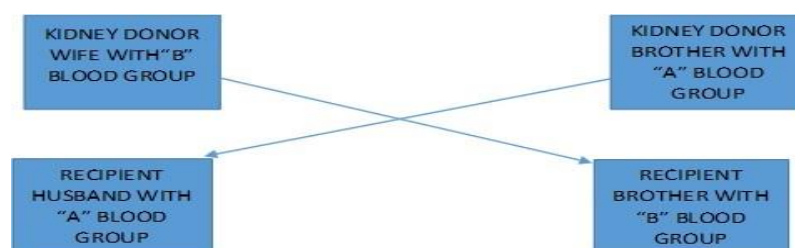


Figure1: Showing Swap Kidney Transplantation between Two Incompatible (Blood Group Mismatch) Donor Recipient Pairs

2. INDIAN SCENARIO ON SWAP TRANSPLANTATION

Swap transplants although common globally were unheard of in India till recently. Locating the history of swap kidney transplant India some of the kidney transplant centers have been performing such transplants from 2000 onwards (**Modi Pranjal 2010**). [1] Families of Muslim and Hindu religions uniting through kidney swap transplantation made headlines in national newspapers not only in 2008 (**Hemant Kumar Rout 2008**) [2] but in 2013 also (**IANS 2013**) [3]. In 2009 the first swap liver transplant between a Nigerian and Indian family united two families of two different nations (**Kounteya Sinha 2009**). [4] All these efforts with fruitful results paved the way for legalizing this option in India and swap transplantation was accorded legal sanction in 2011 in THOA Amendment Act 2011 (**THOA 2011**). [5] The swap transplant is allowed for same organ among donor recipient incompatible pairs. Inter-organ swap is not permitted for example a kidney cannot be swapped for liver and vice versa. Legalizing this innovative option has given hopes to a number of families and has united professionals and people of different castes, religions, gender, as well as countries besides bequeathing hopes to number of families who were battling the end stage organ failures of their loved family members. The medical benefit of organ donation and transplantation through swap transplantation questions the social, religious and political boundaries created by humans. In India Apex Kidney Foundation in Mumbai a non-governmental organization has launched Apex Swap Transplant Registry (ASTRA) in 2011 that is doing pioneering work by maintaining database of such donor recipient incompatible pairs and identifying best matched swap pairs from this database through computer algorithm based on blood group, lymphocyte cross match, age etc (**Tatke Sukhada 2014**).

3. DOMINO TRANSPLANTATION

Domino transplantation is derived from the dictionary meaning of “*domino effect*” which is the cumulative effect that is produced when one event sets off a chain of similar events. Same is true with domino transplantation in which one donation and transplantation sets a chain of similar kind of donation and transplantations. Domino transplants are of three types as follows:-

1. Simple Living Donor Exchange Domino Transplantation:

In certain cases interchange of organs between two donor recipient incompatibility pairs may not solve the problem of incompatible but interchange of organs between three or more pairs may be able to do so. Such kind of interchange between three or more incompatible donor recipient pairs is called simple donor exchange domino transplant.

2. Altruistic Living Non- Directed Organ Donor Initiated Domino Transplantation

At times in countries where altruism in living organ donation is permitted, an altruistic non- directed living organ donor (**Dar Reeta and Sunil Kumar Dar 2014**) [6] enters the domino chain and donates an organ to the most compatible recipient among a group of donor recipient incompatible pairs following which other transplant surgeries take place. An altruistic donor can initiate a chain in simultaneous as well as non-simultaneous domino transplantation.

3. Recipient Facilitated Domino Transplantation:

In some cases a person in need of an organ receives a healthy organ from a living donor or a deceased donor. His own organ which is removed could be healthy or may have some healthy parts like a part of liver or heart valves. The healthy organ or the parts of explanted organ are transplanted into other persons for therapeutic purposes. In these cases the patient gets an opportunity to become a recipient and donor simultaneously. This chain of transplant facilitated by recipient's donation of explanted organ is a possibility with liver and heart domino donation and transplantation.

ADVANTAGES OF SWAP AND DOMINO TRANSPLANTS:

1. Swap and domino transplant has given hope to a number of patients and their family members with incompatible donor recipient pair.
2. It has lent a helpful hand to patients on dialysis to overcome the trauma and pain associated with the procedure.
3. It reduces the competition for deceased organ donation.
4. It increases the survival period of a recipient as living compatible donor's organ generally lasts long.
5. It unites people of different religions, castes, class or even countries.
6. It gives professionals an opportunity to shun rivalries, unite and coordinate the medical marathon involved in extended swap or domino transplants.

In conclusion Domino chains can start with a living related or known unrelated donor, or a deceased organ donor or an altruistic living organ donor as per the legal policies of a country. The domino transplantation are unique in nature with organs like heart, liver and kidney as described separately below:-

1. DOMINO HEART TRANSPLANTATION:

Unlike kidney or liver domino transplantation domino heart transplantation always starts with donation from brain dead donor/brain stem dead donor only. Some patients needing lung transplantation are transplanted with two lungs along with heart from a single brain dead donor simultaneously for the operational benefits. The healthy heart from this heart-lung recipient is removed and transplanted into another patient requiring heart transplant. This type of transplantation is unique as it gives an opportunity to this heart and lung recipient to be the donor and recipient simultaneously. The heart recipient gets heart from a live donor which is not otherwise possible. Papworth hospital in UK in 1988 was the first hospital to start domino heart transplant in which the heart and two lungs of a deceased donor were transplanted into live donor with end-stage lung disease and the recipient's heart was transplanted into another patient awaiting heart transplant for end-stage heart disease (**Oaks T E et al 1994**)[7] This procedure is technically simple, medically helpful and has given good clinical results in a number of such transplants (**Klepetko W et al 1991**).[8]. In a study on 10 such domino heart donors and heart recipients the survival at one, five and ten years was studied. The survival rate at one year was 60% for domino donor in comparison to 90% domino recipient. At 5 years it was 40% for domino heart donor as compared to 70% for recipient and at 10 years it was 30 % for domino donor in comparison to 60% for recipient suggesting good long-term results of the domino procedure (**Raffa GM et al 2010**).[9]

Such domino transplant procedures are also done on pediatric patients. In Columbus children hospital at Ohio in United States a 12 hour domino heart transplant surgery was performed on a five month old child who needed lung transplantation. The lungs and heart of a deceased donor were transplanted together into this tiny baby for its own medical benefit and the healthy heart of this baby recipient was donated and transplanted into a three-month-old baby who was born with a single ventricle in her heart. In this way the youngest baby living heart donor donated heart to the youngest recipient and became the tiny recipient of two lungs and heart together from a deceased donor (**abc News2006**) .[10]

2. DOMINO LIVER TRANSPLANTATION:

Domino liver transplant can be initiated either by a living donor or a deceased donor .The first domino liver transplant (DLT) was done in 1995 in Portugal. Spain the best model in world completed 100th domino liver transplant in 2009 (**R. Matesanz, G. and De La Rosa2009**).[11] the year in which India started its first domino liver transplantation on two children .This procedure on children involved three surgeries sequentially. The 22 month old boy who suffered from Maple Syrup Urine Disease (MSUD) received 20 percent of his aunt's liver. The boy's own liver was removed and was transplanted into 2 year old girl who was battling liver failure owing to a rare condition called Langerhans' Cell Histiocytosis (LCH) (**Kounteya Sinha 2009**).[12] This domino liver transplantation created history as it was the world's first youngest domino liver transplantation.

Domino liver transplantation is usually done by using explanted liver of patient suffering from Familial Amyloidosis Polyneuropathy (FAP) which is a metabolic dysfunction of the liver. In fact FAP is the common indication for domino liver transplantation. This disease presents with clinical manifestations only after 15-20 years of life and starts damaging other organs like heart, digestive organs and peripheral nervous system. When dysfunction starts attacking organs of the person, the person is left with two options either to face death or to get a liver transplant. His liver is fine anatomically and functionally except for this enzymatic defect. While this FAP patient receives liver either from a live or deceased donor, his explanted liver can be transplanted into another patient not suffering from this disease. The explanted organ of the donor is medically safe for transplantation because there is no threat of developing this disease in the recipient for at least 15-20 years. This kind of domino transplants have been done from 1990 onwards. It has been reported by FAP World Transplant Registry that only 2 out of 500 patients having received liver transplants from donors suffering from FAP developed this disease(**Ericzon BG and Larsson M, HE 2008**).[13]

3. DOMINO KIDNEY TRANSPLANTATION:

Domino Kidney transplants are very common as compared to liver or heart domino transplantation. This could be because the need for kidneys for transplantation all over the world is much more as compared to other organs. India needs 1,80,000 kidneys annually whereas approximately 6000 kidneys are transplanted every year (DGHS; NOTP 2011).This

supply of organ comes mainly either from the living related or living unrelated individuals and very few from brain stem dead donors. Kidneys have an advantage over other organs as ischemic time for kidneys is about 24-48 hours that means they can remain outside the body for 24-48 which is much more as compared to liver or heart. (Dar Reeta 2014)[14] The kidneys can be airlifted or shipped out to different parts of a country for transplantation into patients of various races and ethnicities without any hassles. The first domino chain was tried in John Hopkins in USA in 2005 among a number of incompatible donor and recipient pairs (John Hopkins Medicine News 2008)[15].

Domino kidney transplantation can be done simultaneously or non-simultaneously.

3.1 SIMULTANEOUS DOMINO KIDNEY TRANSPLANTATION:

It usually involves a medical marathon in which a group of incompatible living kidney donor and recipient pairs participate. Such kind of operations take months of planning for creating database of all incompatible donor recipient pairs, matching them for compatibility by using advance software, clearing operation theatres, freeing hospital beds and organizing transplant teams to perform end to end operations. Domino kidney transplantation enables patients to get high quality organs. Each donor donates an organ to the best matched recipient among the participating group other than its own incompatible recipient. In exchange the most compatible organ from most suitable donor among the group of donors is transplanted into its own recipient. Such donation is of great therapeutic benefit to all the recipients participating in the chain. The transplantation is carried out simultaneously to prevent renegeing. The surgeries (both on donors and recipients) happen in various hospitals simultaneously. It continues till the last donor in the chain donates to the first recipient in the line as shown in Fig.2 below.

India's first domino kidney transplantation that involved five kidney transplant surgeries, 5 donor surgeries, was done in June, 2013 by using 10 operation theatres, medical and nursing staff in various hospitals. Swap among these 5 pairs crossed sociocultural, religious and class barrier. One person among these pairs was a road side barber (Basu Mihika 2013).[16] In 2014 there were two domino kidney transplants done in India and Australia (Carolyn Martin 2014) [17]. The similarity in these two domino transplantation was that both domino chains involved six donor and six recipient surgeries simultaneously. The dissimilarity in these two domino chains was that in India the donation occurred without the entry of an altruistic donor whereas in Australia the chain started with the selfless act of an altruistic living kidney donor. In other words India's domino chain was simple donor exchange kidney domino transplantation and Australia's domino chain was altruistic donor initiated kidney domino transplantation. India's domino chain was the second and the largest chain in India as compared to Australian chain which was first in their country. This largest historic domino transplantation in India benefited 6 recipients after performing 6 donor and 6 recipient surgeries by a team of 12 anesthetists, 12 urologists, six assistant nephrologists, six vascular surgeons, five nephrologists, 24 assistant surgeons, and 24 nursing staff (Tatke Sukhada 2014).[18] Swap among 6 pairs involved 3 female spouse donors, 2 male spouse donors and one father donor. The domino transplant in Australia also helped 6 recipients who were on dialysis and frustratingly waiting for deceased donor organ transplant. Five Couriers were used to transport the organs across hospitals in Australia.

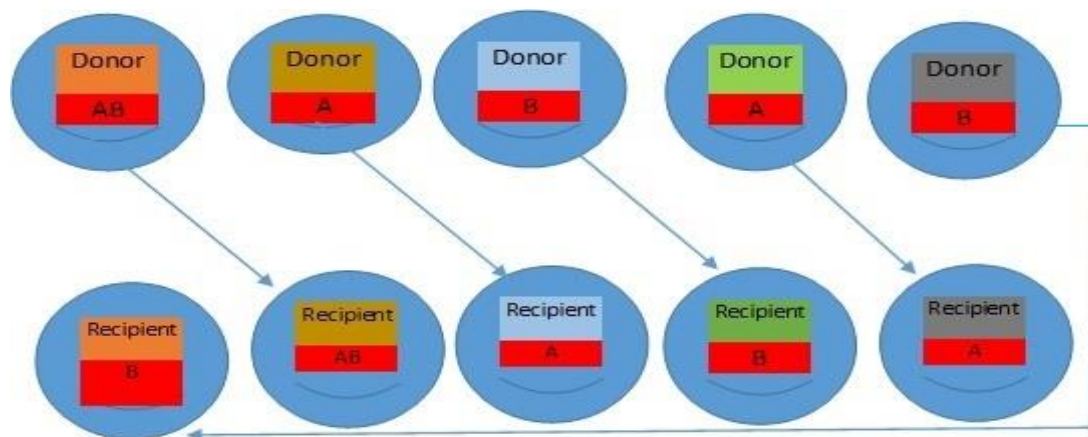


Figure 2: Showing Five Recipients With Different Blood Groups In 5 Donor-Recipient Incompatible Pairs Interchanging Donors With Matching Blood Group In A Kidney Domino Transplantation

3.2 NON-SIMULTANEOUS DOMINO KIDNEY TRANSPLANTATION:

At times kidney domino transplant operations are done non-simultaneously over a period of few weeks to few months which is made possible with the entry of an altruistic living non-directed kidney donor. The altruistic living non directed kidney donor donates first. All the donors of the incompatible donor recipient pairs donate kidney only after his own intended recipient receives the most compatible kidney in the chain. Such chain of transplantation is devoid of any threat of renegeing or irreparable harm to the rest of donor recipient incompatible pairs. The last donor in the chain donates to the person on the waiting list or serves a bridge donor for initiating a new chain. Such domino transplantation also called as non-simultaneous extended altruistic donation (NEAD) are possible in those countries only which allow altruistic non - directed living organ donation like UK and USA.

World's longest domino kidney transplantation chain took US about four months to transplant compatible kidneys to 30 recipients from 30 unrelated compatible donors with the entry of one altruistic donor in the chain. Such a marathon involved huge infrastructure including a number of medical and paramedical persons in 17 hospitals in 11 states of USA in 2012(**Sack Kelvin 2012**).[19] In world's second domino kidney transplant 28 donors and 28 recipients were operated upon within a period of 36 days starting with an altruistic non- directed living organ donor. This "chain 221" of the National Kidney Registry of US involved 56 participants who were operated in 19 transplant centers across US in 2013(**Janet Christenbury 2013**).[20]

The success of these domino transplants lies in cooperation between multiple transplant centers, a computer algorithm to identify chains of transplants, the non-directed altruistic donors, willingness to airlift, ship out the donor organ, use of courier services etc. Active management and dealing with logistic barriers is of great importance in domino chains.

4. CONCLUSION

The swap and domino transplants have given hope to a number of families all over the globe. It has united people of different castes, class, religions, races and nations and has questioned all boundaries created by human beings. Professionals shun rivalries and unite to join medical marathon involved in extended domino transplants. Health is a state subject and it a great challenge to persuade all states to adopt THOA amendments 2011 at the earliest so that the benefit of swap transplantation reaches all incompatible donor recipient pairs in the country. The authorization committees of different states have to be sensitized to this issue of swap and domino transplantation to ensure such donations and transplantation happen without any delay. However it is a big challenge for National Organ Transplant Programme in India to motivate states to start swap or paired donor recipient registries like Bombay based Apex Swap Transplant Registry (ASTR) which has made a number of swap and domino transplant possible.

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