

## ORIGINAL ARTICLE

### Heart Transplantation. Where is Egypt?

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The most extreme idea for surgery in the future is what was casually said by a lay man in the funeral of a beloved famous scientist; "why should not we try to transplant his brain to a "body donor?". He had a superb brain and a very weak heart. What a waste, losing this global mentality?"

This extreme idea may look like the future science fiction movie of a dying old man, going to the operating theater and on waking up he starts looking to his new hands and identifying his new body parts as an another young healthy man or even as a woman.

This introduction may resemble the general response to the idea of heart transplantation (HT) from a victim of head accident to a patient with advanced heart failure in the early 50s. At that time, surgery on the heart was a matter of gambling on the patient's life.

Dr. Dwight Harken, (1910-1993) was an American surgeon (Figure 1). He is considered the father of heart surgery and the creator of intensive care. In the World War II, he removed bullets and shrapnel from the hearts of some 130 wounded soldiers without a single fatality. He was also, the first surgeon to operate on beating hearts. At that era the heart was considered so complex and untouchable from any surgical intervention. He said; "*We discovered that the heart wasn't such a mysterious and untouchable thing after all*" (1, 2). In 1948, Dr. Harken created also the technique of closed mitral commissurotomy.



Figure 1: Dr. Dwight Harken, (1910-1993).

In 1959, Norman Shumway (Stanford School of Medicine), (Figure 2) and his associates, succeeded to transplant the heart of a dog. The latter lived for 8 days. They spent the next eight years perfecting the technique in dogs, achieving a survival rate of 60 to 70 percent. Their late high success rate came from "autotransplantation" experimentation, where the heart would be excised and resutured in place. When he said later; "We started out doing this as a technical exercise and the animals began to survive," he understood



Figure 2: Dr. Norman Shumway (1923-2006).

later that he overcame the puzzling problem of donor's heart rejection (3, 4).

Different types of heart surgery were invented since that time until in 1967, a human heart from one person was transplanted into the body of another by a South African surgeon named Dr. Christiaan Barnard in Cape Town (Figure 3). Dr. Barnard's surgical team removed the heart of a 25-year-old woman who had died following a car accident and placed it in a 55-year-old man dying of severe chronic heart failure. The patient survived for only 18 days (5).



Figure 3: Dr. Christiaan Barnard (1922-2001).

Dr. Barnard used the same techniques described by Norman Shumway on his dog experimentations. However, few months later, Shumway succeeded in the first HT in USA. Many surgeons considered Shumway as the father of HT, since later in 1981, Shumway and Reitz performed the world's first successful combined heart-lung transplant in 45-year-old advertising executive lady, who lived five more years and wrote a book about her experiences. By the late 1980s, they were also transplanting hearts into infants as well (5, 6).

However, because many patients were dying soon after, the number of heart transplants dropped from 100 in 1968, to just 18 in 1970. In Texas, Dr. Denton Cooley performed 21 operations, but an 80 percent mortality rate forced him to quit (7). Later on, in 1969, Dr. Denton Cooley implanted the first completely artificial heart in a human, again on a temporary basis (8). The first permanent artificial heart, designed by Dr. Robert Jarvik, was implanted in 1982 (Figure 4) (9).



Figure 4: Jarvik first permanent artificial heart (1982).

It was recognized that the major problem was the body's natural tendency to reject the new tissues. They were all victims of their own immune systems, which attacked the new heart as if it were a foreign substance.

Five years later after this disastrous first transplant, Jean Borel, a scientist working for Sandoz Ltd Switzerland, discovered the key to suppressing the

immune system during a transplant. After testing various fungi, Borel found that a Norwegian fungus called *Tolyposcladium flatum* (called also, 24-556), proved to be useless as an antibiotic but had amazing immunosuppressive properties and it had an unusually low toxicity. It inhibits certain lymphocytes, or cells that protect the body from foreign objects, such as organs received in a transplant. It was purified into another compound that he called CyA (cyclosporine A) (10). In 1978, it was used for the first time after a successful kidney and bone marrow transplant. While cyclosporine continues to be the number one immunosuppressant drug in transplantation therapy, it is still associated with long term toxicity such as renal failure and cancers (11).

**Magdi Yacoub (Figure 5)**

Although HT started in UK by a series of three performed by Donald Ross in 1968, Sir Magdi Yacoub was involved in the restart of UK HT in 1980. The Europe's longest-surviving HT patient was carried out by Magdi Yacoub at Harefield Hospital, London in 1980 and the patient died in 2005. Sir Yacoub is considered one of the most experts in HT, where the number of heart/lung transplantation performed by his team exceeds 1000 (12, 13). He is known of doing surgery for charity and has a major contribution in training cardiac surgeons in Egypt, although he did not perform this procedure before in Egypt.



**Figure 5:** Sir Magdi Yacoub, the famous Egyptian cardiac surgeon.

Now the procedure of HT begins with removing the beating heart from a brain- dead donor to the matching patient who is usually prepared with immunosuppressive treatment. The heart is stopped with intracoronary potassium chloride injection, and is kept viable under cooling condition for a maximum of 4 to 6 hours. More recently, in Germany (2006), they succeeded to transplant a beating heart preserved in room temperature, where the heart was attached to a special machine called an Organ Care System that allows it to continue beating with warm, oxygenated blood flowing through it (14).

The operative procedure in the hands of a trained surgeon is simple. The patient is attached to cardiopulmonary bypass, the heart and great vessels are dissected and removed except the posterior part of the left atrium with its attached pulmonary veins. The donor heart is sutured in place. The new heart is restarted, the patient is weaned from cardiopulmonary bypass and the chest cavity is closed. This type of surgery is called the orthotopic procedure, while in some cases the patient heart is not removed, and the new heart is positioned so that the chambers and blood vessels of both hearts can be connected to form what is effectively a 'double heart', or

heterotopic procedure. The procedure can give the patients original heart a chance to recover, and if the donor's heart happens to fail as the case with progressive rejection, it may be removed, allowing the patient's original heart to start working again (15)

In the last procedure it is usually interesting to show the patient ECG to medical students, for the differential diagnosis of two different P-QRS complexes in the same tracing (Figure 6). In that case, the donor denervated heart is usually faster than the patient's original heart (16).



**Figure 6:** A long stripe ECG tracing showing P-QRS complexes of 2 hearts (A and B), after heterotopic HT (16).

The prognosis for HT patients has greatly increased over the past 20 years. Survival rate over 5 years is about 73% for males and 67% for females. A review of 885 patients undergoing transplantation at Stanford found that the 5 and 10 year survival rates among patients treated with cyclosporine and OKT3 were 68 and 46 percent, respectively, compared to 41 and 24 percent with prior regimens. The decrease in mortality was due to reductions in the 10 year incidence of death from rejection (5 versus 14 percent), infection (16 versus 50 percent), and graft coronary artery disease (9 versus 13 percent) (17). The world's longest lived HT recipient lived 31 years with a transplanted heart at Stanford University, died in 2009 from cancer (18).

Heart transplantation has now achieved a therapeutic status similar to renal transplantation. It is estimated that as many as 15,000 people per year could benefit from a heart transplant, but only 400 to 1,100 viable donor hearts may be available each year. Donor supply is the most critical determinant of the future of heart transplantation (19).

The guidelines on how a donor heart is selected require that the donor meet the legal requirement for brain death and that the appropriate consent forms are signed.

The clinical diagnostic criteria of brain death in an ambulance or ICU caused by severe head injury or aneurysmal subarachnoid hemorrhage should exclude complicating medical conditions as severe electrolyte, acid-base, endocrine disturbance, or drug intoxication and the core temperature should be above 32°C. Absent brainstem reflexes including coma, fixed dilated pupils (4-9 mm), absent ocular, pharyngeal and facial reflexes and positive apnea test (20).

**HT: Where is Egypt?**

When we were asked by a group of visiting American cardiologists about the number of beds in Cairo University hospitals (Kasr Al Aini), they were markedly astonished

when we told them that we have a very busy hospital with more than 3,500 beds. They were attending our weekly scientific conference, where one of our colleagues presented a case with advanced cardiomyopathy with its investigation results and the suggested management.

One of the American doctors ended his comment about the case suggesting that this patient should wait in the HT raw. The audiences laughed when the chairman said; here we have a raw for everything in our life except HT,.. simply it is not allowed!

With the noise of laughing the American doctor said; sorry.., in Cairo museum, I saw pharaoh's mummies with jars containing their preserved internal organs. Do you still preserve your dead by mummification? The laughter became louder when the chairman answered him; yes.., of course, we mummify them, and we still go to the cinema riding camels. And, we did not know who was mocking whom?

In Egypt, organ transplantation is allowed from living person to a patient in need. The laws concerning transplantation are related to the main international principles of medical ethics. These laws include the principle of 'beneficence' or a practitioner should act in the best interest of the patient and 'non-maleficence' or do no harm to the patient. Lastly, human organs cannot be sold or bought. However, HT is still not allowed due to multiple conflicts about the definition of the donors' death. Traditionally, death is diagnosed when the heart and lung ceases to function.

Some may raise the idea that for victims of brain damage, there is a thin line that separates life from death, and extraction of the heart can be considered as a crime if there is any chance of successful resuscitation. Others may say it is against Islam to remove the beating heart from any victim, but in the Holy Quran, there is no definite saying about the signs of death, and death is mentioned repeatedly as a general philosophical aspect, which is defined by absence of human spirit (Ruh), and announcing death should be pronounced by the experts who have the knowledge to judge it or doctors (Figure 7).

**"And they ask you (O Muhammad, PBUH) concerning the "Ruh" (the Spirit); Say:"The Ruh" (the Spirit): its knowledge is with my Lord. And of knowledge you (mankind) have been given only a little." (translated by Mohsin Khan).**

Figure 7: English translation of holy Quran, Verse "Al-Israa".

سورة الإسراء (آية ٨٥)  
وَيَسْأَلُونَكَ عَنِ الرُّوحِ قُلِ الرُّوحُ مِنْ أَمْرِ رَبِّي وَمَا أُوتِيتُمْ مِنَ الْعِلْمِ إِلَّا قَلِيلًا

This was confirmed in the third international conference of Islamic jurists held in Amman in 1986, they defined legal death and gave the doctors the right to take

the persons off resuscitation even with a still beating heart (Figure 8) (21, 22).

**Resolution of the Council of Islamic Jurist prudence on Resuscitation Apparatus. Amman, 1407 H (1986 G) NO.86-07-3D (5)**

A person is pronounced legally dead and consequently, all dispositions of Islamic law in case of death apply if one of the two following conditions has been established:

1. There is a total cessation of cardiac and; respiratory functions, and doctors have ruled that such cessation is irreversible.
2. There is a total cessation of all cerebral functions and experienced specialized doctors have ruled that the cessation is irreversible and the brain has started to disintegrate.

In this case, it is permissible to take the person off resuscitation apparatus, even if the function of some organs e.g., heart, are still artificially maintained.

Figure 8: Islamic council in Amman (1986), permits stopping resuscitation for a brain dead subject (22).

Now the Kingdom of Saudi Arabia (KSA), the most conservative Islamic country, is playing a major role in formulating ethical Islamic rules in the rapidly expanding field of organ transplantation. In 1996 they established a national cadaveric transplantation program with scientific committees attached to hospitals for early diagnosis of brain death and to co-ordinate organ donation (23).

Advanced HT in KSA can be seen in the article published by Mohamed Al Fagih, 15 years ago, he presented his experience in 25 orthotopic heart transplantation (from 1983 to 1996), in only one center (24).

**Why Not to Use Body Parts of Criminals Sentenced to Death?**

In all communities when the judge or verdicts find that an accused criminal have committed an awful crime against the community, and if the crime in their opinion deserves the maximum punishment, they will announce the sentence of death. The method of applying death penalty has been markedly varied along history and from nation to nation. In the primitive countries they may burn, boil or cut the body parts of the living accused. Jesus was crucified, and Muslims used the sword for decapitation. The idea of all these sadistic methods was a kind of revenge against the accused, and to frighten other people from committing similar crime against their communities. Although the penalty of death was omitted in some countries, the majority of nations find it an important part of their justice. The methods of execution also changed by time from robe hanging, electric chair, gas chamber to the less painful lethal drug injection.

All these sentences of death now a day and all over the history did not stop or reduce the incidence of horrible crimes (Figure 9).





**Figure 9:** An Arabic article from a daily Egyptian journal about the final sentence of death of 10 men. They have been accused of raping under force a married Egyptian lady.

Most of the accused are usually young strong healthy subjects. The question raises, why not to benefit from their dead bodies as a source of organ transplantation to sick people of their community? Killing them is not only a type of revenge, but they should also pay their debt to the community that they markedly harmed it. It can also be considered a merciful sentence; hence the accused will be subjected to a tranquilizer and general anesthesia before his death and extraction of the transplantable body parts as the kidneys, corneas, liver, heart, etc.

We suggest that the law of death penalty should contain an addition phrase “with donation of the accused body parts to sick people waiting for donors”. This will give the chance of unlimited drain of body parts. In this case, the accused will be subjected to full clinical assessment and other investigations including his immunological profile. In the meantime, the recipient will be probably matched and can even be present in a neighboring operating theater to have a beating fresh heart in the case of HT.

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