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Shortage of Organs for Transplantation and its Forensic Considerations

B.R. Sharma and Manisha Gupta
Department of Forensic Medicine and Toxicology,
Govt. Medical College and Hospital, Chandigarh, 160030, India

Abstract: Improvement in transplantation procedures, beginning with the advent of immunosuppressive therapies in the early 1980s, has led to more and more patients benefiting from organ transplantation. At the same time, waiting lists of organ recipients are getting increasingly crowded. Tragically, the supply of donated organs has not kept pace with this demand. Even though each cadaveric organ donor can often supply multiple organs for transplantation, many patients still die before a suitable organ becomes available. This shortage results in a tragic number of potentially preventable deaths. Usually organs are retrieved from only about 15-20% of the eligible cadaveric donors available each year. Increased efforts to encourage organ donation could hence save many lives. However, there are a number of factors limiting the procurement of organs and accordingly, therapeutic cloning that perhaps can yield still better results needs to be considered as an alternative.

Key words: Organ retrieval, organ donation, organ transplantation, stem cells, therapeutic cloning

INTRODUCTION

The most important limiting factor for transplantation programs world-wide is an acute lack of available organs (Cohen and Wight, 1999; Astarcioglu *et al.*, 1999). Majority of the organs for transplantation are donated from patients in whom 'brain-stem death' has been diagnosed and who are then ventilated to maintain adequate oxygenation and circulation-the so called non-heart-beating donors (NHBDs) (D'Allessandro *et al.*, 1995; Casaville *et al.*, 1995). A review of potential donors in a catchment area serving a population of 22 million, reported that major causes of death among potential donors were head trauma (49%) and cerebrovascular events (33%). In these patients, the commonest cause of death is spontaneous/traumatic intra-cranial hemorrhage as a result of Road-traffic accidents (Gortmaker *et al.*, 1996).

During the last two decades, deaths from traffic accidents reportedly fell by 30% as per data collected from 13 European countries and the US, while in the UK; deaths from intra-cranial hemorrhage fell by 70% during the same period (D'Allessandro *et al.*, 1995). Though this speaks volumes about the improvement in the level of health-care being provided, it also points to the important fact that the number of potential donors may be decreasing, which in turn is seriously limiting the transplantation programs. Currently, in the US, 62,000 people are in the National Waiting List, which is growing at an average rate of 16% per year, with a new name being added to it every 16 min (United Network, 1999). However, despite an adequate donor pool, only 15-20% potential donors become actual donors (Bart *et al.*, 1981; Tolle *et al.*, 1987), as a result about 4000 patients die each year waiting for a solid organ (United Network 1999), while an estimated 12,500-27,000 potential organ donors die each year (Evans, 1990; Stuart, 1984).

The diagnosis of death, itself, has been debated for centuries (Palo and Viitala, 1999). Finland was the first where the notion of brain death was legally accepted, along with the traditional idea of

death being caused by cessation of cardio-respiratory function (Powner *et al.*, 1996). Mollaret and Goulan described the irreversible loss of all brain functions as *coma depasse* in 1959. In 1968, brain death was accepted as the criterion of death by an 'Ad-hoc Committee of the Harvard Medical School'. The Conference of Medical Royal Colleges and their Faculties defined brainstem death in 1976 and 1979 in the UK. It concluded that the state of brainstem death was a state of unsurvivable coma, but stopped short of equating it to death itself (Wace and Kai, 2000). The Federal Chamber of Physicians of Germany passed the guidelines of brain death in 1982; the transplantation law was passed in 1997 (Kleidienst *et al.*, 1999). However, while most of the western countries have adopted the Harvard Criteria of brain death, ongoing discussions have been reported on the definition of death in Germany (Bernat, 1996; Sharma and Harish, 2005). The main reason for the very low rate of organ donation in Germany has been reported to be the refusal of the consent by the donor/relatives (Kleidienst *et al.*, 1999).

Many anesthetists administer anesthesia to the NHBDS (Wace and Kai, 2000). The transplant lobby considers this a big problem because administering anesthesia is perceived as an additional difficulty in telling the relatives that the donor is not actually dead but in an unsurvivable coma. However, the alarming haemodynamic responses to the pain of surgery during the retrieval operations, though spinal in nature, only emphasize the fact that the current brainstem death criteria do not suffice to demonstrate that the entire brainstem is invariably dead (Keep, 2000). The procedure causes a mean increase of 31 mm of Hg in blood pressure and a mean heart rate increase of 23 beats per minute (Wetzel *et al.*, 1985). This haemodynamic response could be considered to represent an organism in distress and probably occurs at a spinal level. According to Shann (1995), brainstem death should not be a requirement for death. He suggests that it is theoretically possible for the reticular activating system and hence consciousness to be preserved despite the loss of brainstem reflexes, yet consciousness cannot be preserved without the cerebral cortex. The one important question that we have to ask ourselves is: would we be content to cremate the body of our loved one in the knowledge that it would contract its limbs and that there would be a sharp increase in its heart rate and blood pressure the moment it enters the furnace (Keep, 2000).

A more structured approach to and heightened awareness of potential organ donors may improve the number of donors. As a significant proportion of potential donors are to be found in the trauma centers and in the ICUs, trauma and critical care teams must become aware of the importance of organ procurement and be skilled in securing maximum donation from these potential donors. Identifying all potential donors, determining brain death in a rapid and reliable manner, approaching the families of all potential donors for consent and aggressively managing all medical issues of the potential donors are necessary to achieve increased rates of actual organ donation (Grossman *et al.*, 1996; Jenkins *et al.*, 1999).

DEFINING DEATH

Death has been defined as the cessation of all the vital functions and signs, a total stoppage of circulation of blood and cessation of the vital functions of an organism such as respiration, pulsation, etc., (Black's Law Dictionary, 1999). Traditionally, it is defined as permanent and irreversible cessation of respiration and circulation (Gradwhol's Legal Medicine, 1968). However this definition has certain disadvantages, for example, in general anesthesia/trauma and such other cases, it is very common to maintain respiration and circulation artificially. Secondly, in heart/lung surgeries, it is necessary to stop the function of heart and the lungs till the surgery is over and guillotine cases can be maintained artificially indefinitely with heart-lung machines.

The concept of heart-beating cadavers came into vogue with the introduction of successful kidney transplants in the 1950s (Razek *et al.*, 2000) and 'Brain' was put forward as the main organ

responsible for determining the death of the individual. Brain Death was proposed by two French physicians, Mollaret and Goulon in 1959 to explain Death (Sharma and Harish, 2004). The reasons given were that (1) Brain cannot be maintained artificially. (2) It is the seat of conscious and hence, the individuality of a person and (3) It integrates, regulates and co-ordinates all bodily functions. They coined the term Comma de Passe and their criteria to define death were: (1) Absence of spontaneous nervous activity above the level of spinal cord. (2) Fixed, dilated and non-reacting pupils. (3) Inability to spontaneous respiration and (4) Isoelectric (Flat) Electro-encephalogram.

However, the concept was not widely accepted. In 1968, the Ad Hoc Committee of the Harvard Medical School to Examine the Definition of Brain Death was constituted to arrive at a standardized definition of brain death. Its recommendations, known as the Harvard Criteria of Brain Death (Beecher *et al.*, 1968) included: (1) Unreceptivity and unresponsivity. (2) Absence of spontaneous movements for 1 h. (3) Apnea for 3 min, tested with a nasal cannula delivering oxygen and demonstrating failure of respiratory effort with PaCO₂ of more than 60 mm Hg. (4) Absent elliptical reflexes (Pupils fixed, dilated and not responding to light. Absence of ocular movement to head turning and irrigation of the ear with ice-water. Blinking absent, no evidence of postural activity and absent corneal, pharyngeal and tendon reflexes). (5) Iso-electric (Flat) Electro-encephalogram. A repeat examination after 12 h was required to yield same results to declare a person brain dead.

Mohan Das and Chow in (1971) put forward the concept of Brain-stem death. Reasons put forward by them, in support of this concept were (1) Medullary cells are the most resistant to anoxia. (2) The centers for respiration and circulation are present here and (3) All information to and from the brain and the body passes through the brainstem. Therefore, if these cells are dead, the rest of the brain cells must have died. Their criteria for defining 'brain-stem death' were (1) known but irreparable brain damage, (2) absent spontaneous movements (When observed for 1 h), (3) apnea for 4 min and (4) absent brain-stem reflexes (Gag, cilio-spinal, vestibulo-ocular reflexes, etc.). EEG was not mandatory, However, same status must persist when the patient is examined after 12 h (Mohandas and Chou, 1971).

At present, Brain-death criteria in the US are based on the Report of the Medical Consultants on the Diagnosis of Death to the President's Commission on the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research (Report of the Medical Consultants, 1981). It requires loss of brain stem function, loss of cortical function and that the condition is irreversible.

Absence of brainstem function is documented by testing for pupillary response, corneal reflex, oculocephalic and oculovestibular reflexes. Loss of medullary function is demonstrated with an apnea test. For this the patients are removed from the ventilator (while maintaining adequate respiration through endotracheal oxygenation) until the PaCO₂ reaches 60 mm Hg. An absence of spontaneous respiration with this stimulus is consistent with loss of brain stem function (Ropper *et al.*, 1981). Demonstration of a lack of blood flow can be done by the Nuclear Medicine Brain Flow Scan-an accurate, inexpensive test that may be performed at the bedside (De La Riva *et al.*, 1992; Laurin *et al.*, 1989). This is an important adjunct to the diagnosis of brain death and its use as a confirmatory test for brain-death' has been well described (Wieler *et al.*, 1993; Wilson *et al.*, 1993). However, it must be emphasized that the diagnosis of brain death is clinical and no guidelines require any ancillary tests to confirm this clinical impression. An individual with irreversible cessation of the entire brain, including the brain stem, is pronounced brain dead.

1. Cessation is recognized when evaluation discloses:

- Cerebral functions are absent, cerebral unresponsivity and unreceptivity are present and
- Brain stem functions are absent-pupillary light/oculovestibular/oropharyngeal etc. Apnea is tested with a nasal cannula delivering oxygen and demonstrating failure of respiratory effort with PaCO₂ of more than 60 mm Hg; spinal cord reflexes may persist after death; true decerebrate or decorticate posturing or seizures are inconsistent with the diagnosis of death.

2. Irreversibility is recognized when evaluation discloses:

- The cause of coma is established and is sufficient to account for the loss of brain function,
- The possibility of recovery of any brain function is ruled out and
- The cessation of all brain functions persists for an appropriate period of observation or trial therapy;

Confirmation of clinical findings by EEG is desirable when objective documentation is needed to substantiate the clinical findings. Complete cessation of the circulation to the normothermic adult brain for more than 10 min is incompatible with the survival of brain tissue. Absent cerebral blood flow, in conjunction with the clinical determination of cessation of all brain functions for at least 6 h, is diagnostic of death. A significant change from the Harvard criteria is the recognition that spinal and tendon reflexes are preserved in brain death and the interval between repeat examinations may be as short as 6 h.

The British Transplant Society has advocated the following recommendations to diagnose death for the purposes of Organ Transplant (Conference of Medical Royal Colleges, 1981). (1) A minimum of two doctors to certify death. Both of them should in no way be interested in or be a part of the transplant team. (2) In cases of irreversible or total brain death, where respiration is dependent on mechanical ventilation, the decision to stop it must have no connection with transplant considerations.

Their criteria for defining brain-stem death are---In patients with structural damage of brain, where there is no suspicion of depressant drugs or hypothermia, brain death may be diagnosed, if over a period of 12 h, both the following conditions are fulfilled: (1) No spontaneous respiration, when observed over a period of 3 min, PaCO₂ being 36-44 mm Hg prior to disconnecting the respirator (Oxygen to be fed through a nasal cannula during this period). (2) Absent brain-stem reflexes viz. fixed and dilated Pupils, without any III/IV nerve lesion and absence of Occulo-vestibular and Corneal reflexes and no motor responses above the level of Foramen Magnum. EEG is not mandatory, spinal reflexes are insignificant and the Blood Pressure and Heart rate are not taken into consideration.

LEGAL ASPECTS

One of the first litigation in this respect was the Bruce Tucker case (1964) (Tucker vs. Crower, 1999). Bruce Tucker was a construction worker. While on field, a heavy load fell on him and severely damaged his head and brain. In the hospital he was put on a respirator, diagnosed to be brain-dead and the respirator cut off. Later, he was again put on respirator and his kidneys transplanted. William Tucker, his brother, charged the four doctors with causing homicide and transplanting organs of his brother without his consent. The Court held that the doctors were not guilty of homicide as a person, having suffered irreparable brain damage and whose bodily functions cannot be sustained without artificial means, is dead but of malpractice, as no consent was taken before transplantation.

In case of brain-stem death, the content and timing of the information to be given to the bereaved family is very important. The family has to understand and accept this new concept of death, because even though the patient is dead, he has a heartbeat and respire, albeit through a machine. For this it is essential that trained informers, who have completely understood the concept of brain-stem death and are competent enough to explain it to the family members in a simple language, while maintaining their trust, be recruited. These informers can then become the corner stone of organ-retrieval program of the hospital.

ISSUES OF CONSENT

The current system of organ procurement has been unable to cope with the increasing demand for organs. As a result there now exists a severe and steadily worsening shortage of organs, world-wide

(Spital, 1991). This shortage is not due simply to a lack of donors, but also to a failure to convert potential donors into actual donors. At present the organs retrieving rate is only 50% of all suitable donors (Ewans *et al.*, 1992). Many patients therefore needlessly remain on the waiting list or even die while suitable and life-saving organs are either buried or burnt.

Under the US Uniform Anatomical Gift Act, all adults have a right to decide for themselves whether or not they wish to become organ donors when they die (Lee and Kissner, 1986). But, only a few take advantage of this law by filling the advance directives (Spital, 1993). Again, even when the directives are available, almost all organ procurement organizations still ask the family for permission, despite the explicit stipulation in the Act that the donor's wishes must be honored and should not be over ridden by the wishes of the family (Prottas and Batten, 1991).

This need to obtain the family's consent presents a formidable barrier to organ procurement (Kokkedee, 1992; Lee *et al.*, 1992). Indeed, the family's refusal may be the leading cause of donor loss (Cutler *et al.*, 1993; Dennis *et al.*, 1994). Most of the families are ill equipped to make this decision, not only because of the stressful nature of the situation, but also because only a minority is actually aware of the deceased's wishes regarding organ donation. According to Cohen (1992), we ask the wrong persons, at the worst possible times, what they should never have been asked at all. According to a study (Spital, 1995), if Mandated Choice became a law, nearly 2/3rds of the public would sign up to become donors at the time of death. Furthermore, if the swing group of undecided could be convinced to say yes, then under the mandated choice, about 3/4ths of the population in the US would be committed organ donors.

It has been made mandatory in the US, through the 1986 Omnibus Reconciliation Act, that all hospitals refer all potential organ donors to their Organ Procurement Organizations (OPO) and that families of all potential organ donors become aware of their option to donate (Grossman *et al.*, 1996). It has been observed that organized and humane approach to all potential donor situations may significantly improve donor rates (Gortmaker *et al.*, 1996). Families grieving over the unexpected death of their loved ones usually resent the timing of such requests, which must be within a few hours for the organs to be viable for transplantation (Iserson, 1993; Overcast *et al.*, 1984). By requiring that individuals make their preferences, mandated choice would reduce the stress placed by the current system on the families and physicians of the dead or dying patients whose organs could be suitable for harvesting.

Spain has one of the highest organ donation rates in the world and that is due to the establishment of a highly structured approach to organ donation with the designation and formal training of donation coordinators in every hospital with potential donors. It has presumed consent laws. Under presumed consent, it would be assumed that people consent to cadaveric organ donation unless they or their families register an objection. Thus, in contrast to the present system wherein people are given a chance to opt in to the organ donation system by signing the donor card or registering their desire to be donors (Katz, 1985), under the presumed consent, they would automatically be in the system unless they decide to 'opt out' by registering their refusal to donate. A comparison of 6 European countries in 1990 showed significantly higher rates of organ transplantation in Belgium, France and Australia, which operate under the system of presumed consent; than in the UK, Germany and the Netherlands, which operate under the system of 'opting in' (Roels *et al.*, 1990).

PRACTICAL PROBLEMS

Despite efforts to standardize the definition of brain death, a lot of variation exists among institutions, states and countries in the pattern of brain-death determination (Hanely, 1995; Jenkins *et al.*, 1997). Complications related to prolonged supportive care, often as a consequence of delay in the diagnosis of brain death, reduce the availability and suitability of potentially transplantable

organs. According to a report (Lucas *et al.*, 1987), around 17-25% of potential donors are lost because of medical failure while awaiting the formal declaration of brain death. The Rapid Brain Death Determination (RBD) Protocol, developed by the Division of Trauma and Surgical Critical Care of the Hospital of the University Of Pennsylvania (HUP) envisages to reduce the time of declaration of brain-death from 12.4 to 3.4 h (Jenkins *et al.*, 1997), thereby increasing the number of actual donors and the number of organs per donor through a decrease in the incidence of medical failure.

The potential donors are not without problems. Severe physiologic derangements are common in the brain-dead and present serious challenges in their management, particularly hemodynamic and metabolic abnormalities, resulting in a loss of valuable organs (Duke *et al.*, 1991; Hayek *et al.*, 1990; Nygaard *et al.*, 1990). Autonomic instability and hypotension occur in 80-85% cases (Hayek *et al.*, 1990; Nygaard *et al.*, 1990). Agents used to treat high intracranial pressure, traumatic blood loss, a sudden increase in ICP, etc. may contribute towards hypotension. Conversely, severe systemic hypertension may ensue, resulting in marked myocardial ischemia. Hypotension is also known to be caused by neuroendocrine failure, due to pituitary-hypothalamic dysfunction (Mertes *et al.*, 1994), leading to neurogenic diabetes insipidus and a marked decrease in the levels of thyroid hormone, resulting in the inhibition of mitochondria and associated phosphate depletion, anaerobic metabolism, hemodynamic instability and organ deterioration (Novitzky and Cooper, 1997).

Aspiration pneumonitis, pulmonary contusions, neurogenic pulmonary edema and pneumonia are common complicating factors in patients with significant head injury. Hence, it has been estimated that only 1 in 20 organ donors have lungs suitable for donation due to rapid deterioration of pulmonary function following brain death (Ali, 1994). Abnormalities in coagulation are also common (Ali *et al.*, 1992). However, it has been suggested that the medical failures during the time leading up to actual organ procurement in brain-dead patients may be preventable with early invasive hemodynamic monitoring, aggressive rewarming and liberal transfusion therapy (First and Fanning, 1990).

COMMERCE OF ORGAN TRANSPLANT

Organ transplantation is now an established treatment for patients with organ failure. Of the transplant operations, kidney transplant is the most common. Despite all efforts, organs are now available for only a minority of patients. Hence many patients had resorted to 'procurement by payment'. However, the swift and intense condemnation of this practice by one and all led to its ban throughout the advanced world. This forced these people to look beyond the boundaries of their country's laws and they made India their favorite destination since the 1980s. Some of the manifold reasons were: a) a vast population, b) lack of any laws regulating organ donation, c) readily available trained doctors willing to do the needful for a consideration, d) good infrastructure and e) enterprising middlemen who could arrange for anything and everything. The largest chunk of clientele was from the oil-rich West Asian countries.

Accordingly an urgent need for a comprehensive legislation for regulating the removal of organs from living persons and cadavers was felt by the Government of India, as in the absence of any law, removal of organs from 'brain-stem-dead' cadavers was not possible. The Transplantation of Human Organs Bill (1992) was therefore introduced that finally became an Act on 8th July 1994.

According to the Transplantation of Human Organs Act (1994), 'Brain-stem death' means the stage at which all functions of the brain-stem have permanently and irreversibly ceased and is so certified by a 'Board of Medical Experts' consisting of:

- The Medical Superintendent/in charge of the hospital in which 'brain-stem' death has occurred.
- A specialist, nominated by the Medical Superintendent/in charge of the hospital, from a panel of names approved by the Appropriate Authority.

- A neurologist/neurosurgeon nominated by the Medical Superintendent/in charge of the hospital, from a panel of names approved by the Appropriate Authority.
- The doctor under whose care the 'brain-stem' death has occurred.

However, the Act permits the Authorization Committee to approve of organ donation from an unrelated individual if it is convinced that the donation is out of love, affection and emotional attachment for the recipient and no financial transaction is involved. This clause has been exploited to an extent that in the Annual Conference of the Indian Society of Nephrologists held in Dec. 2003, it was freely admitted that commerce in kidney donation was being carried on unabated.

CONSIDERING THERAPEUTIC CLONING AS AN ALTERNATIVE

An important application of the stem cell research relates to obtaining tissue or organs for transplantation. A child who needed an organ or tissue transplant might lack a medically suitable donor. Couples in this situation have some times conceived a child coitally in the hope that he or she would have the correct tissue type to serve, for example as a bone marrow donor for an older sibling (Kassirer and Rosenthal, 1998; Annas, 1998). It might eventually be possible to procure suitable tissue or organ by cloning the source DNA only to the point at which stem cells or other material might be obtained for transplantation, thus avoiding the need to bring a child into the world for the sake of obtaining tissue (Rogers and Ashraf, 2000). Therapeutic cloning aims to develop medical therapies for which cloned embryos grown only up to 14 days can harvest the stem cells useful in treating many diseases. Central to therapeutic cloning are stem cells, which could be derived from several sources, including early embryos, germ cells of aborted fetuses blood cells of the umbilical cord and some adult tissues such as bone marrow. These cells are capable of developing into a host of tissues that could be used to treat degenerative diseases such as Alzheimer's disease and Huntington's chorea. These tissues/organs derived from therapeutic cloning would have the advantage of being free from danger of rejection (Fazal, 2000).

According to a report, researchers from Australia, Israel and Singapore have grown human nerve cells from embryonic stem cells. The research could have implications for the treatment of Parkinson's and Alzheimer's disease, stroke and other degenerative diseases. Doctors at the Monash Institute of Reproduction and Development, Victoria, Australia and doctors from Israel and Singapore have developed a significant number of nerve cells from two cell lines derived from four embryos (Loff and Cordner, 2000). However, research involving the formation or use of a zygote, where the research proposes that the zygote continue to syngamy, is banned in Victoria as is any destructive research on an embryo. To get around this, the team imported the stem cells from the National University of Singapore. The University obtains these cells from donated embryos created for in vitro fertilization. Once the stem cells have been extracted, the embryo is no longer viable. In what appears now to be a legislative oversight research on these cells once created is not illegal. Despite this blurring of the edges of legality, which will no doubt become the subject of bio-ethical discussion, the Victorian government has welcomed news of this advance (Loff and Cordner, 2000).

After the successful cloning of Dolly the sheep in Scotland in, 1997, President Bill Clinton banned federal funding for research into human cloning and proposed a law forcing a five-year moratorium on such work. Scientists argued that a ban on research into human cloning could well stall medical progress. It has been claimed that brain dead clones could be created as a source of perfectly matched organ transplants. We can (and should) distinguish the cloning of cells and tissues from the cloning of human beings by somatic nuclear transplantation and permit the former while prohibiting the latter (Sharma, 2004a).

At one stage, the federal government of the United States had announced that it will fund medical research using human embryos in a hope that stem cells, obtained from donated embryos or aborted pregnancies can repair diseased tissue enabling them to function normally. The new policy was put in place despite a 1996 federal law championed by abortion opponents in Congress. According to these guidelines, funds from the National Institutes of Health could be used for research on stem cells only if they were derived from embryo leftover from infertility treatments. Such tissue is always marked for destruction anyway and as such the objection of antiabortion campaigners that it will be necessary to destroy human embryos to obtain the stem cell, a process they condemn as immoral and illegal, is taken care of (Gottlieb, 2000).

However, a detailed exploration is needed. Firstly, because the potential medical benefits of the research are such that it would be verging on the immoral not to attempt to find out what and how achievable, these might be. Secondly, because it is essential that society develop regulatory instruments sufficiently sensitive to distinguish between the responsible and the irresponsible application of whatever knowledge emerges. Fortunately, such exploration is beginning. Britain's Human Genetics Advisory Commission in a discussion paper proposed circumstances in which some forms of cloning-related research should be allowed to proceed. In the United States, similar debates have been held within professional medical societies (Sharma, 2004b).

CONCLUSION

Organ donation is a unique process that involves cooperation among the many parties involved, such as, donors, families and medical staff, as well as the government and society, as a whole. Even with such cooperation, the organ transplantation programs all over the world have been hampered by one persistent problem: A world wide shortage of organs. Many countries have developed national and international systems for organ procurement and allocation through a combination of legislation, Organ Exchange Organizations (OEOs), transplant coordinators, publicity campaigns, donor cards and professional training programs; but none have proved sufficient to solve this important problem.

Many workers have enunciated their theories in an attempt to define-the moment of death. The reason is that death is a piece-meal process, where different organs/tissues die at different intervals of times, depending upon their susceptibility to anoxia. With modern techniques, circulation and respiration can be maintained indefinitely in comatose patients. Therefore it is essential to diagnose death in these 'brain-dead' patients in an unambiguous, universally accepted way for the purposes of procurement of organs so as to minimize problems of litigation on charges of homicide/malpractice, etc.

Drawing a distinction between organ development by cloning and the human cloning and further research in the field of stem cell can perhaps, be a turning point in saving the lives of many dying for want of donated organs and the ever-increasing list of organ recipients. There is a need for a purely scientific global debate to arrive at a consensus as to the potential benefits of such a research, simultaneously addressing the ethical and practical issues. However, it must not be forgotten that the way we handle this issue, provides a measure of our maturity in addressing critical issues at the intersection between the research community and the society which has to confront the uncomfortable truths and capabilities that research can yield.

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