Review Article

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Brain-Stem Dead Certification, Organ Donation & Transplantation

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ABSTRACT

Organ donation is a boon to persons who are suffering from chronic end organ disease & illness. In 1994, Govt. of India has legalized the organ donation concept as "Transplantation of Human Organs (THO) Act" to streamline the activities of living donor & transplants. Due to Indian regulations (THO act 1994), multi-organ retrieval & transplant is made possible from brain dead donors of India. Due to increase in vehicular accidents, there are at least 10-15 patients in various ICUs of each city who are brain-stem dead & are under treatment on ventilator at a given time. There are important technical issues involved from declaration of Brain stem death to retrieval of organs & transplant. This articles aims at discussing the legalities, technicalities and coordination involved in the process.

"DO NOT TAKE YOUR ORGANS TO HEAVEN - THEY ARE REQUIRED HERE"

Introduction :

Organ donation is a boon to persons who are suffering from chronic end organ disease & illness. Such patients may not survive if the failing organ is not transplanted. Transplantation of organs is a ray of hope for survival of these patients. Human Organs & tissues can be donated immediately after natural death and after brain death.

The concept of brain death was first introduced in Paris in 1959 by two French physicians. In 1968, an Ad-Hoc committee of Harvard Medical School defined the brain death as "Irreversible Coma" with the patient being totally unreceptive and unresponsive with absence of all cranial reflexes & no spontaneous breaths / respiratory efforts during 3 minutes' period of disconnection of ventilatory support. Experiment has shown that, a few cubic centimeters of tissue called **'Brainstem'** which is located beneath the aqueduct of sylvius anteriorly & the floor of 4th ventricle posteriorly is the vital section of brain that determines the consciousness & ability to breathe spontaneously. Destruction of this tissue leads to brain death.

In 1994, Govt. of India has legalized the organ donation concept as **"Transplantation of Human Organs (THO) Act"** to streamline the activities of living donor & transplants. Due to Indian regulations (THO act 1994), multi-organ retrieval & transplant is made possible from brain dead donors of India.

The organs / tissues which may be donated after natural death are: Cornea, Bone, Skin, Blood vessels. However, the organs which can be retrieved & donated from Brain-stem dead Donor in addition are critical organs e.g. Kidneys, Heart, Liver, Lungs, Pancreas.

Approximate incidence of road accident deaths is 1,90,000-2,00,000 every year. Non-wearing of helmet by two wheeler accidents account for 70-80% of head injury & polytrauma. Due to increase in vehicular accidents, there are at least 10-15 patients in various ICUs of each city who are brain-stem dead & are under treatment on ventilator. In India, 'The Transplant Coordinators & Social Workers' try to convince the near relatives about Organ Donation Concept & Law, but many times relatives are reluctant to giveconsent. The reasons may be social taboo, rituals or dispute amongst the relatives etc. No consent for organ donation puts financial and mental burden on relatives for the ongoing treatment in ICU. BSD patient eventually dies with sepsis & organs failure.

There is a great disparity between supplies of donated organs & demand of organs for chronically ill patients with end organ failure patients who are in waiting list for transplantation. Almost 85-90% of

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organ transplants are possible only from Brain-stem Dead Donors and Head injury accounts for 60-80% of such brain deaths.

There are important technical issues from declaration of Brain stem dead to retrieval of organs &transplant - like documentation & consent, relevant investigations, vasopressor support and maintaining the emotional balance of relatives. The night hours' issues of ICU at public and private sector hospitals are of availability of essential drugs, maintaining organ perfusion, emotional balance of relatives till retrieval to postmortem, communication in rural areas to relatives, co-ordination between retrieval & transplant team, problems of ICU monitoring equipment e.g. ventilator, ABG machine, Echo, Laboratory facilities etc. Other factors are in relation to medico-legal issues, certification, information to nodal/ state authority of ZTCC, ROTTO, SOTTO. Coordination between the Intensivist, Retrieval team, Transplant team & Hospitals about time to time status of BSD, investigations, tissues to be retrieved, timings of retrieval, identification of wait list patients with blood group by transplant hospitals, tissue typing, willingness of recipient for operation, green corridor & early postmortem of BSD patient. A brain stem dead patient if develops cardiac arrest is not a good case for organ retrieval as organs may have developed hypoxic insult and survival of such organs after transplant is questionable.

Brain death certification (THO ACT) : Two clinicians are required to certify brain death who should not have interest or benefit in any way from transplantation of deceased donor organs / tissues. Usually brain-death certification or Form-10 signing team - non-organ retrieval team consists of

1) Administrator of Hospital

2) Neurologist or Neurosurgeon

3) Physician

4) Anaesthesiologist

5) Treating Intensivist of the patient.

One of these two clinicians should be nominated members of panel of doctors listed by the state government for this purpose. The legal time of death of BSD patient is taken as when the second set of brainstem death tests are done. The certification should be done as per THO act. In medico-legal case, the forensic expert is also required for the certification.

Consent form of organ donation (Form no- 8) is to be signed by relatives before proceeding for BSD certification.

Establishing Brain death Diagnosis :

Aim is to confirm absent brain stem reflexes & no spontaneous breaths on apnea test. The tests should be performed on the right patient & at right time i.e. comatose patient on ventilatory support with cause of coma being either head injury or other Irreversible structural brain damage on CT.

Functional causes of that coma should be ruled out are -

a) Primary Hypothermia
b) Alcohol Intoxication
c) Neuromuscular blockades (e.g. Use of Muscle relaxants),
d) Use / consumption of CNS depressants drugs (e.g. sedative drugs),
e) Severe metabolic / endocrinal disturbances
f) patient should have no circulatory levels of any drug that could cause coma & thereby establishing the loss of "Brain- stem reflexes" at the bedside.

Absence of brain stem functions is essential for establishing the diagnosis of Brain death.

CLINICAL TESTS TO ESTABLISH BRAIN STEMDEATH.

1) Absence of Pupillary reflex,
2) Absence of corneal reflex,
3) Absence of Vestibulo-ocular reflex,
4) Absence of Gag & Cough reflex,
5) Absence of cranial nerve response,
6) Doll's Eye Phenomenon,
7) Plantar Response
8) Apnoea Test - is performed twice at interval of at least six hours. It is the final test to establish death of respiratory centre of brain stem and hence to declare Brain Stem Death. It demonstrates that

the spontaneous respiratory response fails to occur even in the presence of stimulatory drive from CO2. To avoid hypoxia of vital organs, patient is ventilated with 100% oxygen for 5 minutes before disconnection from ventilator just before the apnoea test. Patient is disconnected from the ventilator for 10 minutes. The oxygen supply catheter is inserted up to carina via tracheal tube / tracheostomy tube & during the test period, 100% oxygen is supplied to patient.

The CO2 tension (PaCO2) in blood increases by 2 mmHg/min (0.3kPa/min) during apnoea testing. Before apnoea test, If initial PaCO2 is about 40 mm/Hg (5.3kPa/min), then after 10 minutes, the arterial CO2 tension is likely to be 60 mm/Hg (8kPa). However rise in arterial CO2 tension to 50-55 mmHg is acceptable & should provide sufficient stimulatory drive for spontaneous respiration in an intact respiratory centre.

Role of Cerebral Angiography & EEG for Brain death testing : These tests are not done routinely. EEG is not of much use to establish brain stem death. The four vessel angiography is used to show absence of cerebral blood flow & confirm the death of whole brain. If there is any doubt in diagnosis of brain death, one should not proceed for a request for organ donation & ventilator should becontinued. In children, there remains uncertainty about reliability of clinical brain stem testing. Inneonates specially, organs for transplantation should not be removed in the first seven days of The Radio - Isotope brain scanning has been recommended under the age of one year when brain- stem death certification is required.]

"The THO act does not require EEG or cerebral angiography for brain death certification, however they may substantiate the diagnosis of brain death in special circumstances."

Organ donation request : If Brain stem dead patient is suspected and if relatives are willing for organ donation, the process of BSD certification is to be started at earliest. Form 8 is to be filled by relatives before the apnoea test & other clinical tests to establish brain stem dead certification. Form-10 will be filled by BSD certification committee. Once it is confirmed that patient is Brain-stem dead, relatives are to be informed about the fact & further process of organ retrieval process, time of post-mortem & probable time the body will be handed over to relatives for rituals is ascertained. Simultaneously, the similar information is to be shared with Zonal Transplant Coordination Committee (ZTCC) who is controlling & supervising authority for retrieval & transplant procedure. On request 'ZTCC - the regional committee' permits the process of organ retrieval, allotment of organs and transplantation at certified centres.

In India due to the heat, it is advisable to do it quickly & requires coordination. The different teams operate simultaneously and sometimes at different locations and requires getting surgeons from different specialties together for both donor & recipient surgeries. Generally, there is no age bar for organ donation. **All potential donors will require a virology screening to prevent possible transmission of disease from donor to the recipient.**

Support of the Brain Dead organ donor : The clinicians / intensivists should switch the focus of the management of the BSD patient for preservation of the organ function and optimization of tissue oxygen delivery. This will keep the organs in optimal condition so that the recipient has the best chance of recovery after transplant.

Contraindications to Organ Donation :

a) Malignancy (Except: Primary brain tumors, low grade skin malignancies; Ca in situ of Cervix),
b) Uncontrolled sepsis,
c) Active viral infections - Hepatitis A & B, cytomegalovirus, herpes simplex virus and HIV / AIDS.

Haemodynamic instability occurring during coning or brain herniation is the result of an autonomic storm (sudden massive increase in systemic catecholamine levels and increase in sympathetic activity). The major metabolic stress and impairment of organ perfusion occurs which affects post-transplant organ function. This is of clinical

significance in chemo-sensitive organs like the heart, liver where immediate graft function is essential. Following autonomicstorm, later there is a profound reduction in sympathetic outflow & catecholamines levels and decreases to below baseline values. The resting vagal tone is abolished because of destruction of the nucleus ambiguous. The subsequent chronic maintenance phase of brain stem dead donors is frequently characterized by hypotension. Complications are related to the profound physiological disturbances - hypotension, arrhythmias, pulmonary edema, hypoxia, diabetes insipidus, metabolic acidosis, disseminated intravascular coagulation and infections.

Cardio-respiratory support : The overall management goal is to ensure adequate tissue oxygen delivery. While optimizing the functions of different organs, it is necessary to pay attention to the details e.g. large volume fluid resuscitation is important for maintaining kidney function, but a watch is kept to avoid pulmonary edema.

Invasive monitoring of arterial and central venous pressure : The usual problems encountered in a brain death patient are related to : hypotension, arrhythmias and cardiac arrest, hypoxaemia, electrolytes issues & ventilator problems etc. The management of hypotension with proper fluid management, appropriate use of vasopressors & management of electrolyte is the cornerstone of therapy. Dopamine, Dobutamine & noradrenaline are used to maintain blood pressure. Also renal support, endocrine changes : e.g. diabetes Insipidus & hyperglycemia, Infection, coagulopathy are to be dealt with immediately & appropriately. Hypothermia : Core temperature should be monitored using rectal thermometers. The core temperature should be maintained above 35 degrees Celsius. **After brain death, the body becomes poikilothermic because of the loss of central temperature control mechanisms.** The treatment includes use of humidified and warmed ventilator gases; warmed intravenous fluids & blood products; heating blankets. Sometimes a “hot blower” next to the patient is the best solution to maintain the body temperature.]

Conclusion :

A severe shortage of organs, the world over, has led to increase pressure on the intensive care staff for early identification of the brain dead donor and optimum management of this condition. The diagnosis of brain death as per the Indian THO act (1994) is based on simple clinical bedside & subsequent adoption of THO by states has made it possible in India to use Brain stem dead pool of patients for organ retrieval & transplantation of organ to needy chronically ill patients.

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