`Guidelines For
MANAGEMENT OF THE BRAIN DEAD ORGAN DONOR IN THE OPERATION THEATER (OT)

1. The main aim of management during the process of organ retrieval from a brain-dead donor is to avoid ischemia of the donor organs and retrieve these organs in an optimal state. The care provided to the donor is continuation of the management in the intensive care unit, after the patient was declared brain dead. In the following paragraphs one would find key principles of management of a brain-dead organ donor in the operation theater (OT) which would help the anaesthesiologist to guide his approach towards such cases [1], [2].

2. **Preliminaries**: As soon as it is decided to harvest the organs of a brain dead donor, the anaesthesiologist should verify the brain-dead certificates as per the policy of the hospital. The criteria for declaring brain death should be well known to every anesthesiologist participating in cadaveric organ donation programme.

    a. It should be ensured once again that the consent from the family members or from the one, who are in possession of the body, is in order.
    b. In the medico legal cases, he should also satisfy himself that the proper authorities have been informed and permission taken to carry on the process of retrieval of organs.

3. **Pre-operative Assessment**: Even though, it would have been deliberated upon by the ICU team, the anaesthesiologist should look at any absolute contra-indication to the organ donation. Amongst all, the specific concerns would be any transmittable infective diseases. All donors should be assessed as for any major surgical procedure. One must
    a. Review previous history
    b. Review the management of the donor in ICU especially degree of ventilator and inotropic support.
    c. Review Electrocardiogram, chest x-ray, arterial blood gases, echocardiography
    d. Transesophageal Echocardiography (TEE) is often used in multi visceral retrieval to assess the myocardial and valvular function.
    e. Examine all the recent biochemistry reports and results of specialized investigations (Refer to guidelines for MANAGEMENT OF THE BRAIN DEAD ORGAN DONOR IN ICU)
    f. Check the patency of arterial line and CVP lines and also the ongoing drug infusion therapy. Occasionally these patients would have a PA Catheter or some other cardiac output monitor in place.

4. **Transferring to the OT**: Special care must be taken during the transfer as donor is vulnerable to episodes of haemodynamic instability anytime. The entire exercise of transferring the donor from the intensive care unit to the operating room should be undertaken with the continuous monitoring since transport frequently precipitates

instability, often because of change in ventilation or delivery of infusions. Hence special attention must be paid to airway and particularly infusion pumps delivering vasopressors.

5. Time out to be carried out according to institutional practice.

6. **Preparation of OT**: Before transferring the donor to the theater, the OT should be kept ready. The OT should be kept warm and warming blanket and fluid warmers should be used to prevent gross hypothermia. The preparation should proceed as for any major surgery keeping in mind that a large number of these donors can developed hypotension, diabetes insipidus, cardiac arrhythmia, disseminated intra vascular coagulation (DIC), pulmonary edema etc.

7. **Monitoring in Operating Theatre**: Once the donor is shifted onto the operating table, monitoring should be commenced. The essential monitors are as under:-
   a. Pulse oximetry
   b. 5 lead electrocardiogram (ECG)
   c. Invasive arterial blood pressure
   d. Central venous pressure
   e. Urine output
   f. Temperature monitoring with nasopharyngeal probe
   g. Pulmonary Arterial Pressure and Cardiac output (in selected cases having LVEF<45% and needing increasing inotropic support)

8. **Anaesthetic Management**: In a stable donor, preoperative management can simply be continued into the operating theater. However, the clinical focus shifts from patient preservation to organ preservation. The main aim is to maintain haemodynamic stability for optimal organ perfusion until organs are retrieved from brain dead patient.

   a. **Anaesthetic Agents:** It can be argued that these patients being brain dead, are unlikely to have any sensation and hence may not need anaesthesia. However there are good reasons for giving anaesthetic agents to these cases.
      i. There is as yet no way to know whether these cases indeed have no sensation.
      ii. There is some scientific evidence that inhalational anaesthetics such as Isoflurane and sevofluranecan cause ischemic preconditioning of organs and this may improve graft organ function by offering protection against cold and warm ischemia [3], [5], [6].
      iii. Inhalational anaesthetic may have a beneficial effect by causing peripheral vasodilation.

   b. **Other drugs:**Some donors show spontaneous or response to stimulus when the surgery starts. This is also called **mass reflex** and is a part of the spinal reflex whereby there is tachycardia, hypertension, perspiration and involuntary movements. Lazarus sign which is seen as movements of the arm and hand towards the body, can be very disturbing for those involve in organ retrieval and the staff present the

operating theatre. It is therefore mandatory to give the following before surgical incision [9]:-

i. Muscle relaxants (Vecuronium 0.1mg/kg) are given to allow adequate surgical exposure and suppress the possibility of spinal-reflex-induced patient movement [9].
ii. Analgesia can be provided with Narcotic analgesic-Fentanyl 1-5 μg/kg.
iii. Air and oxygen mixture can be given.

c. **Goals of Anaesthetic Management:** During anaesthesia, cardiovascular function, oxygenation, acid-base balance, electrolyte levels, glucose, and temperature should be maintained within the physiologic range. Essentially, the goals of anaesthetic management remain similar to what has been prescribed in their management in the ICU (Table-1). (Refer to guidelines for MANAGEMENT OF THE BRAIN DEAD ORGAN DONOR IN ICU).

d. **Fluid Management:**

i. Fluid deficit is corrected with appropriate solution using balanced salt solution like ringer lactate or colloid like starch or starch albumin.
ii. The goal is to keep CVP between 6-10 mm Hg and <6mmHg if lungs are to be harvested
iii. One should remember that during a multi-organ procurement, the collaborating specialists have varying opinions on optimal intravascular volume.
   1. In a stable patient, one may keep the CVP "low" till heart and lung are harvested.
   2. Thereafter, the CVP is raised to 10-12 mmHg for harvesting solid organs – Kidney & Liver.
iv. As anaesthesiologists, one should make an attempt to keep all teams informed about the donor's condition and vital parameters in the operating room. (Refer to guidelines for MANAGEMENT OF THE BRAIN DEAD ORGAN DONOR IN ICU).

Table -1: Goals during Anaesthetic Management

S.No	Parameters	Values
Haemodynamic Parameters		
1.	Mean Arterial Pressure	60 mmHg
2.	Systolic Blood Pressure	> 100 mmHg
3.	Central Venous Pressure(CVP)	6-10 mmHg
4.	Pulmonary Capillary Wedge Pressure (PCWP)	< 12 mmHg
5.	SVR	800-1200 Dyne/Sec-Cm^5
6.	Cardiac Index	>2.4 L/min/m^2
Ventilatory Parameters		
7.	Tidal Volumes	6-8 ml/Kg

8.	Positive End-Expiratory Pressure (PEEP)	5 Cm H_2O
9.	Partial Pressure Of Arterial Oxygen(PaO_2)	>100 mm Hg
10.	$PaCO_2$	35-45 mm Hg
11.	FiO_2	40%
12.	SpO_2	>95%
Others		
13.	Target level of Haemoglobin	10 g/dl
14.	Urine output	>100 ml/h or, >0.5ml/kg/hr

e. **Vasopressors & Hormonal Replacement Therapy:**

i. Vasopressors may be required in the donors who are not responsive to fluids.

ii. Vasopressin could be considered as the first line vasopressor as it might be useful in diabetes inceptors as well as vasoplegia.

iii. Norepinephrine & Epinephrine could be further added based on the requirement. Norepinephrine and Epinephrine are not recommended in a dose >0.05mcg/kg/min in view of right ventricular dysfunction[8].

iv. Dopamine is often insufficient in profoundly vasoplegic patients.

v. One may consider adding or switching to noradrenaline infusion when dopamine alone is unable to maintain haemodynamics in a dose of 10µg/kg/min.

vi. However it must be remembered that the catecholamine therapy should be kept to the minimum. This becomes particularly important if concurrent hormonal replacement therapy (HRT) is used which has a catecholamine-sparing effect in the brain-dead patient besides improving organ recovery and its function when transplanted. By and large, the need of HRT is usually established in the ICU itself, however according to studies, it can be effective even if started as late as sternotomy. Hence, before starting the surgery, the need of hormone replacement therapy (HRT) should be deliberated upon. Hormonal resuscitation is especially important if hear is to be recovered. (Refer to guidelines for MANAGEMENT OF THE BRAIN DEAD ORGAN DONOR IN ICU).

f. **Miscellaneous**:

i. Heparin bolus to be given – as surgeon's request

ii. Mild hypothermia is not an issue at the time of surgery where as deep hypothermia can cause cardiac rhythm abnormalities as well as affecting coagulation status. Usually, this would have been tackled in the ICU.

iii. Adequate dieresis (>0.5 ml/kg/hr) is maintained and excessive urine output is replaced with 0.45% sodium chloride. Desmopressin may also be required if high urine output persists.

iv. Hyperglycemia if it persists, is treated with infusion of insulin in titrated doses. Aim to keep the blood sugar between 120-180mg%.

v. Prophylactic broad spectrum antibiotics according to local infection control policy.

vi. In recent studies, administration of N-acetylcysteine (NAC) 30 mg/kg one hour before procurement, and 300 mg through portal vein before cross

clamping was demonstrated to improve graft survival when compared with control group[4].

9. Broad Surgical Steps:

a. The anaesthesiologist should be familiar with surgical steps so as to keep pace with requirements of various surgical teams, more so in case of multi-organ harvesting.
b. After preparing the donor from neck to pubis and a long midline incision is made from the suprasternal notch to the pubis. Depending upon the stability of the donor, either the thoracic or the splanchnic dissection may follow.
c. In a haemodynamically stable donor, dissection is more deliberate before donor is heparinized and cold-flushed. It may even be possible to plan in-situ splitting of the liver graft.
d. In an unstable donor with imminent haemodynamic collapse, harvesting of thoracic organs should be forsaken, the abdominal organs should be rapidly flushed and cooled and organs are removed en bloc for further dissection on bench.
e. If the pancreas is to be harvested, the duodenum is flushed with an antibiotic or betadine solution through a nasogastric tube.
f. The portal circulation is cannulated.
g. The abdominal aorta is ligated and cannulated just above the bifurcation.
h. The heart is arrested, the aorta is clamped at the diaphragm, and the organs are flushed with preservative solution.
i. Quick uniform cooling is essential to minimize warm ischemic damage to the various organs. The UW solution is commonly used as the preservative solution which is responsible for maintaining a colloid-oncotic, osmotic, and electrolyte balance across cellular membranes in the preserved organ.
j. In general the order of organ removal is as follows: heart and lungs first, followed by removal of liver, pancreas and both kidneys. Corneas are the last to be retrieved.

10. Issues for the Anaesthesiologist during Procurement:

a. Any drop in blood pressure to be informed to the surgeons as this might require hastening of the process and early cross clamping of the aorta.
b. After the dissection of thoracic and/or abdominal organs is complete, the donor is anticoagulated with 300-500 U/kg of heparin prior to cannulation of aorta.
c. Anaesthesiologist may be asked to take blood samples for further investigations such as irregular antibodies[9].
d. During the procurement procedure, donor hemodynamic responses are quite variable. Heart rate and arterialpressure usually rise as incision is given and continue to rise for next half an hour. This occurs as a result of activation of both sympathetic and humoral (adrenal medullary) spinal reflex arcs.
e. Since, this vasoconstrictor effect is generated peripherally, beta – blockade is logical intervention. A short acting drug should be preferred since donor haemodynamics becomes more heterogeneous as surgery proceeds.
f. Bradyarrythmias should be treated with a direct-acting beta-agonist because the brain-dead patient is unresponsive to atropine.

g. Usually, there is no requirement of any investigation during procurement. However in case of any doubt, biochemical parameters such as Blood sugar, Electrolytes and Arterial blood gas levels may be assessed.

h. Ventilation may be discontinued at the time of aortic cross-clamping, and this time should be noted on the anaesthetic record. At the end of the operation it is important that the body is closed with proper skin suture in a continuous manner and is cleaned and packed in a respectful way before being handed over to the relatives.

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CHECKLIST		
S. No.	**Content**	**✓/✗**
1	Consent of the donor family – ***Name & Relation***	
2	Brain death certification – 1 & 2	
3	Police clearance (Medico Legal Case)	
4	Systolic blood pressure - >100mmHg	
5	Temperature - >35°C	
	Vasopressor:	
	a. Norepinephrine	
	b. Vasopressin	
	c. Epinephrine	
	d. Dopamine	
6	e. Dobutamine	
7	Methylprednisolone	
	Thyroxine:	
	a. Levothyroxine	
8	b. Eltroxin/ Thyronorm	
9	Blood group/ type	
10	Serum Electrolytes – Sodium/ Potassium/ Calcium	
11	ABG	
12	Complete blood count	
13	KFT – Blood urea nitrogen, serum creatinine	
14	Liver enzymes – SGOT/ SGPT	
15	APTT/ PT	

16	Chest X-Ray	
17	Ultrasound Abdomen	
18	ECG	
19	Echocardiogram	
20	Blood cultures x 2 sets	
21	Urine culture	
22	Tracheal Aspirate (Gram stain/ Culture in case of potential lung donor)	
23	HIV I & II	
24	HbsAg	
25	Anti HBC Total	
26	Anti HCV	