Introduction

Organ transplantation has revolutionized the management of many chronic diseases. Whilst it is a complex process, it can offer individuals with end stage organ failure improved quality of life, freedom from the burden of on-going treatment and improved survival. For the families of deceased donors, organ donation may offer the reassurance that some good has come from the passing of a loved one, whilst for society as a whole, organ donation and transplantation can prove a cost effective strategy in the management of chronic disease ***(Cota et al; 2013)***.

The ultimate goal of organ transplantation is life extension for patients whose life expectancy would otherwise be measured in weeks or months, as well as an improvement in the quality of life. This applies to many people who suffer from end-stage disease of liver, kidneys, small bowel, heart, or other organs. While the concepts outlined in the following discussion deal mainly with specific organs, many of the concepts and principles are applicable to other solid viscera such as liver, kidneys, pancreas, small bowel, and lungs. Important advances in the last 30 years have contributed to the enormous success of transplantation of many organs. The major factors are:

1. Improved surgical techniques.
2. Improved immunosuppression.

3. Increased willingness of families to donate the organs of deceased loved ones.
4. Development of methods to successfully preserve organs ***(Churchill. 2003)***.

Transplanted organs can come from living and deceased donors. Unfortunately there is a persistent gap between the numbers of patients on waiting lists for organ transplants and the availability of suitable organs (see Figure 1). This has fuelled renewed interest in deceased donation after circulatory death (DCD) or after brain stem death (DBD) ***(NHSBT activity report. 2011)***.

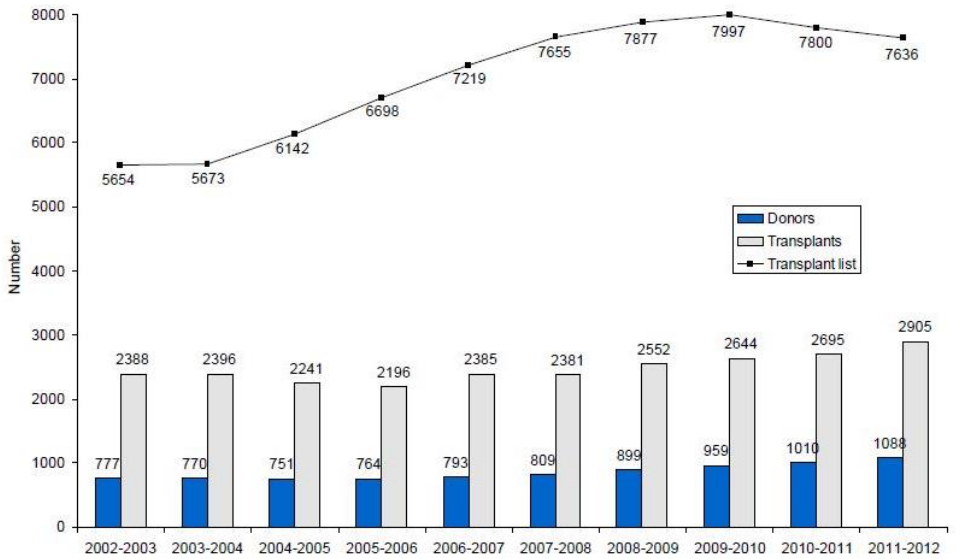

Figure (1). Number of deceased donors and transplants in the UK, 1st April 2002 – 31st March 2012, and patients on the active transplant list at 31st March each year ***(Cota et al; 2013)***.

The definition and diagnosis of death are central to deceased organ donation. Death can be legally and formally defined as either circulatory death or brain death. Circulatory death is defined as the irreversible cessation of circulatory function whilst brain death is the irreversible loss of function of the brain and brain stem. The term donation after circulatory death has replaced the previously used terms non-heart beating donation and donation after cardiac death. Donation after brain death, previously known as heart beating organ donation or donation after brainstem death, is defined as the retrieval of organs after confirmation of death using brain stem death testing criteria ***(NSHBT activity report. 2011)***.

Brain stem death (BSD)

Irreversible cessation of conscious brain activity together with loss of the ability to breathe. This is confirmed by standard tests performed by experienced (more than 5 years post full GMC Registration) medical staff

Donation after brain stem death (DBD)

The donation of an organ or organs after death has been certified following tests confirming absence of brain stem function. The majority of organ donors are cared for in the ICU setting. However a potential organ donor may be identified in the Emergency Department (ED). Solid organ donation (heart, lungs, kidney, liver, pancreas and small intestine) is possible

after the patient has been diagnosed Brain Stem Dead, and where their heart is still beating (DBD). All patients who are potentially brain stem dead should have brain stem death tests performed in accordance with the **Academy of Medical Royal Colleges** Code of practice for the Diagnosis and Confirmation of Death **(2008)**. The upper age limit for DBD is 85 years. ***(Academy of medical royal college report. 2008)***.

Donation after circulatory death (DCD)

The donation of an organ or organs after death has been certified following permanent cessation of the heartbeat. In DCD (liver, lungs, kidneys and pancreas) is possible after the decision has been made that further active treatment is not in the patient's best interests and withdrawal of treatment is planned. Criteria for who can donate after circulatory death changes from time to time although currently these include a maximum age limit of 80 years. ***(NICE. 2011)***.

LEGALITIES OF ORGAN AND TISSUE DONATION

The legalities of organ and tissue donation fall into three different categories:

1. Determination, documentation and the pronouncement of death
2. Obtaining consent from the legal next-of-kin
3. Obtaining consent from the medical examiner ***(President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research; 1981).***

1- Certification of Brain Death

Brain death must be determined clinically by an experienced physician and in accord with the accepted medical standards. Because of the major consequences of the diagnosis of brain death, consultation with other physicians experienced in the relevant clinical examinations and diagnostic procedures is advisable ***(Canadian Neurocritical Care Group. 1999)***.

It is generally accepted that considerable clinical experience in the determination of brain death is desirable when evaluating the patient. In as much as a precise clinical examination forms the foundation for brain death determination, it would appear to be desirable to have a

neurologist or neurosurgeon involved in the assessment of all such patients ***(Wijdicks. 2000***).

In 1996 Pallis and Harley both acknowledges that any physician with sufficient clinical experience may perform an examination for determination of brain death. To minimize perceptions of conflict of interest, guidelines may exclude those involved in transplants following organ procurement in evaluating patients for brain death**.**

In 2002 Wijdicks documents some of the variability in requirements for the declaration of brain death. In the United States, state statutes may specify specific specialties and the number of examiners required for the determination of brain death. For example, in Virginia, a specialist in neurosciences is required. Although a single physician performing two examinations is more commonly required, some statutes mandate independent evaluations by two different physicians. There are no data to support the suggestion that having a second different physician involved in the evaluation for brain death reduces the risk of errors in clinical evaluation. Despite this lack of evidence, Florida requires two physicians, one of whom is the primary treating physician and the other a board-eligible or board-certified specialist in neurology, neurosurgery, internal medicine, pediatrics, surgery or anesthesiology. In two states, Georgia and Alaska, a registered nurse may be delegated authority to declare brain death, although a physician must

subsequently certify brain death within 24 hours. Virginia confers limited authority to registered nurses in the certification of brain death**.**

In the United Kingdom, two physicians with skills in a related specialty are recommended. One of these must be a consultant while the second may be either a consultant or a senior registrar. Although certain specialty consultants are preferred, there is no specified specialty requirement for determination of brain death ***(Wijdicks. 2000).***

و طبقا للائحة التنفيذية لقانون زرع الاعضاء المصري و الصادرة عام ٢٠١٠ ؛ تم تنظيم نقل الاعضاء من المرضى حديثي الوفاة من خلال مادتين كالتالي:

- **الفصل الثاني (المادة ١٠) و نصها كالآتي:**

تُعد اللجنة العُليا لزرع الأعضاء البشرية – من خلال الأمانة الفنية لها – قوائم بأسماء المرضى ذوى الحاجة للزرع من جسد إنسان ميت، وذلك علي أساس الأسبقية في تاريخ قيد تلك الأسماء في السجل المُعد لذلك بالأمانة الفنية وفقاً لنموذج طلب القيد المرفق بهذه اللائحة. ويُعد السجل من نسخيتن إحداهما لقيد الأسماء برقم كودى لا يجوز الاطلاع عليه إلا لأعضاء لجنة تنظيم القوائم بالأمانة الفنية ورئيس اللجنة العلمية، أو بناءً علي قرار من النيابة العامة أو تصريح من المحكمة المختصة عند وجود طعن في صحة البيانات المدونة به، والآخر لقيد الأرقام الكودية فقط، ويجوز الاطلاع علي هذا السجل لمن يرغب من ذوى الشأن. ولا يجوز تعديل هذه الأسبقية إلا إذا المريض في حاجة ماسة

وعاجلة لعملية الزرع وفقاً للقواعد الطبية والإجراءات التي تحددها اللجنة العُليا وتصدر بقرار من وزير الصحة، كما لا يجوز علي أية حال تخطى الترتيب الذي أوردته القوائم المذكورة بسبب يرجع إلى عدم قدرة المريض علي دفع نفقات عملية الزرع، كما يُشترط لتعديل الأسبقية في الحالات العاجلة أن يتقرر إحتياج المريض للزرع العاجل وفقاً للمعايير التي تُقرها اللجنة العُليا. وتُحفظ سجلات القيد الشار إليها إليكترونياً وورقياً في غرفة خاصة بالأمانة الفنية مؤمنة تأميناً كافياً، ولا يجوز تداول هذه السجلات خارج اللجنة أو الاطلاع عليها إلا في حدود ما نصت عليه الفقرة السابقة. وتُحصل نفقات عملية الزرع من المريض طبقاً امتوسط تكلفة الزرع في المنشآت المرخص لها بالزرع، وفي حالة عدم قدرة المريض علي سداد هذه النفقات يتولى الصندوق المنصوص عليه في المادة / ١١ من القانون صرفها له، وتحدد الجنة العُليا المعايير والإجراءات التى تُتَبع لإثبات عدم قدرة المريض علي السداد.

- **<u>الفصل الثالث (المادة ١٤) و نصها كالآتي:</u>**

بمراعاة أحكام المادة / ٨ من قانون زرع الأعضاء البشرية وكذلك الأحكام والضوابط المنصوص عليها في هذه اللائحة، لا يجوز نقل أى عضو أو جزء منه أونسيج من جسد لإنسان ميت إلا بعد ثبوت موته ثبوتاً يقينياً تستحيل بعده عودته إلي الحياة، ويكون إثبات ذلك بموجب قرار يصدر باجماع الآراء من لجنة ثلاثية تُشَكّل في كل منشأة من الأطباء المتخصصين في أمراض أو جراحة المخ والأعصاب، وأمراض أو جراحة القلب والأوعية الدموية، والتخدير أو الرعاية المركزة، تختارها اللجنة العُليا لزرع الأعضاء البشرية بناءً علي ترشيح من المنشأة. ويجب أن يوَقَّع القرار من جميع أعضاء اللجنة مجتمعين، وأن

يتضمن اسم وتخصص كل عضو بخط واضح ومقروء، وأن يُسجل في سجل خاص يُنشأ لهذا الغرض. ويُحظر علي اللجنة إعلان قرارها بثبوت الموت إلا بعد أن تُجرى الاختبارات الإكلينيكية والتأكيدية اللازمة للتحقق من ثبوت الموت طبقاً للمعايير الطبية التي تحددها اللجنة العُليا مستهدية بالمعايير التي وضعتها اللجنة المُشَكّلة بالقرارين الوزاريين رقمى ٥٢٠، ٥٤٥ لسنة ٢٠٠٨، ودون الإخلال بحقها في تعديل تلك المعايير في ضوء ما يُستجد من أبحاث ودراسات علمية مستقبلاً، ويصدر بالمعايير التي تضعها اللجنة العُليا قرار من وزير الصحة. وعلي اللجنة الثلاثية أن تعلن قرارها في حينه إلي أسرة الميت وذويه، فاذا اعترض أحد الأقراب من الدرجة الأولى علي هذا القرار وجب إثبات الاعتراض في محضر تُحرره المنشأة اهذا الغرض، ويتضمن رد اللجنة علي الاعتراض. وللجنة – في سبيل أداء مهمتها – أن تستعين بمن تراه من ذوى الخبرة والمتخصصين من الأطباء علي سبيل الاستئناس دون أن يكون لهم صوت في المداولة. ولا يجوز أن يكون لأعضاء اللجنة أو من يتم الاستعانة بآرائهم علاقة مباشرة بعملية الزرع أو برعاية أى من المتلقين المحتملين من بين الواردة أسماؤهم بالقوائم المُعدّة لهذا الغرض طبقاً لأحكام المادة / ١٠ من القانون.

THE AIM OF THE WORK

The aim of this work is to review the current medical literature regarding the role of the intensivists and the anaesthesiologists in the preoperative and intraoperative management of the deceased donors of organ transplantation.

DIAGNOSIS OF BRAIN STEM DEATH

Definition of brain stem death

The concept of brain death dates to 1959 with the introduction of "coma dépassé," a state beyond coma indicating loss of life functions such as reflexes, consciousness, and mobility. In 1968 the Harvard committee on brain death described "irreversible coma" (what is now described as brain death), incorporating most of the current clinical evaluation techniques. The Harvard criteria have become the basis for much of current brain death protocols ***(Matis. 2013).***

It is well known that the death of the human beings' brain is considered as the most important hallmark of death. Several terms and definitions regarding brain death are available, but two definitions are mainly accepted and used. These two definitions are the "whole brain death" and the "brainstem death". The "whole brain death" is a clinical scenario that includes complete, irreversible, and definitive loss of brain, and brainstem functions. The second term so-called "brainstem death" is generally used in the UK, and is based on irreversible cessation of all brainstem functions leading first to unconsciousness and respiratory arrest and, then to cardiac arrest .There are several controversies related to the term brain death. Some authors find the "whole brain death" term as a limited one, and at the same time insert the term "higher' brain death" which includes neocortical loss of consciousness,

awareness, and memory. So using this definition a vegetative state may be diagnosed and the patient be wrongly declared dead. The concept of "whole brain death" is universally accepted ***(Domi et al., 2013).***

ANATOMY:

The brain is made up of three main embryological segments (fig.1-1):

- Fore-brain (prosencephalon). Cerebral hemispheres, thalamus and hypothalamus
- Mid-brain (mesencephalon).
- Hind-brain (rhombencephalon). Pons, medulla oblongata, cerebellar hemispheres.

The brainstem is the physical link between the cerebral cortex and the spinal cord and it consists of the midbrain, the pons and the medulla. Most of the cranial nerve nuclei are contained here.

In addition the pons contains the reticular activating system that is vital for cortical arousal and conscious awareness, whilst the medulla contains centers that control cardio-respiratory function ***(Niranjan, 2011).***

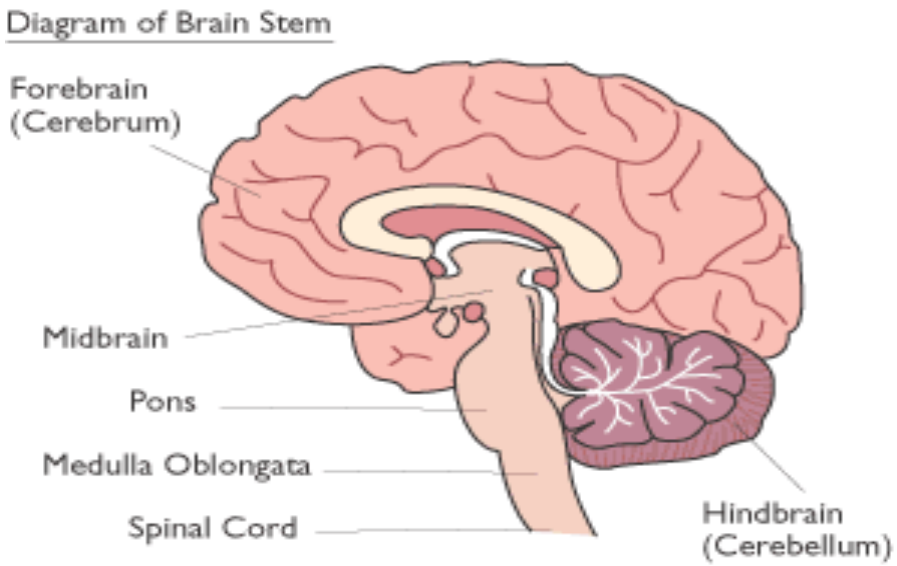

Figure (2): Anatomy of human brain ***(Niranjan. 2011).***

Diagnosis of brain stem death

Brain death diagnosis includes a medical history suggestive for brain death, clinical examination, and imaging tests. It is logical that brain death may be a result of acute central nervous system catastrophe (cerebrovascular accident), severe cranial trauma, or multitrauma. The physician must exclude all anesthetic and muscle relaxant drugs effects, hypothermia, endocrine deficiencies, especially hypothyroidism, severe electrolyte and acid-base abnormalities. Clinical diagnosis is based on a triad of coma, brain stem function cessation, and apnea ***(American Academy of Neurology. 2005).***