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**Original Research Article**

# From Neuro-Resuscitation to Organ Donation

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**Abstract:** *Introductio*n: Encephalic death (ED) is one of the consequences of severe head trauma (TBI), and the donor in a state of encephalic death is an unavoidable solution to the shortageof transplants. The aim of our study was to detect the transition to ME in MCT and to assessthe possibility of performing multi-organ retrieval from the deceased donor. *Material and Method*: prospective study of TCGs admitted to the Salim Zemirli health hospital who had progressed to ME, it began in February 2017 over a period of three years. We collected the following data, incidence of ME, age, sex, medical history, Glasgowscore on admission, pupil status of donors in ME, mean time to onset of ME, mean durationof graft resuscitation, availability of monitoring, paraclinical investigations and treatment necessary for the management of a donor in ME. *The results:* A total of 175 MCTs were included, 16% of these MCTs were found to be in the ME state, the diagnosis of ME was clinical with paraclinical confirmation by transcranial doppler, these donors benefited from therapeutic management without limitation of care. The average age was 35 ± 12 years, medical history was present in 35.71% of cases. The average Glasgow score was 5.63 ± 0.324, with pupillary anomalies such as anisocoria in 28.57% and mydriasis in 21.42%. Theaverage time to onset of ME was 3 ± 1.23 days; the average resuscitation time was 44.06 ±8.79 hours; EEG was not available in our department. For the treatment of diabetes insipidus,we noted the absence of desmopressin. *Conclusion*: Organ harvesting from a deceased donoris technically possible in our establishments.

**Keywords:** Donor in a state of brain death, severe cranial trauma.



## INTRODUCTION

Encephalic death (ED) is defined as the irreversible destruction of all cerebral functions in the brain as a result of cessation of cerebral circulatory function in a subject with a beating heart [1]. Encephalic destruction eliminates central control of respiration, as well as regulation of circulatory, thermal and endocrine homeostasis [2]. Encephalic death (ED) is evoked by a clinical diagnosis and confirmed by paraclinical examinations. The incidence of brain death (ED) varies from one country to another; while in France most studies report a rate of 1 to 2% of all hospital deaths, in Spain, where ED is more actively recorded, the rate is 2% [3]. Similarly, the incidence of EM varies from one department to another, with a higher rate in intensive care units, estimated in France and other countries at 7 to 13% of deaths. The rate is higher in neuro-intensive care units, at 15 to 20% of deaths, and the number of potential donors is estimated at between 3,300 and 3,800 per year [1]. Encephalic death complicates many serious acute neurological pathologies, in particular [4] strokes, head trauma and post-anoxic encephalopathy. The donor in a state of death represents an essential donor for obtaining transplants and coping with the shortage of transplants. The aim of our study was to detect the transition to ME in TCG and to assess the possibility of multi-organ procurement from these donors.

## MATERIAL AND METHOD

Prospective study carried out at the Salim Zemirli health hospital, a structure specialising in the management of severe trauma, on TCGs that have progressed to ME, the study began in February 2017 over a period of three years. We collected the following data: incidence of transition to ME, age, sex, medical history, Glasgow score on admission, pupil status, mean time to onset of ME, mean duration of graft resuscitation, availability of donor management resources in EME, The data were entered into an EXCEL file, and statistical analysis was carried out using SPSS version 20 software and Epi info Version 7 software. Results were expressed as mean, standard deviation, percentage and confidence interval.

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# THE RESULTS

**Descriptive analysis of sample characteristics:**

Our study included 175 severe head trauma patients, and 16% of these severe head trauma patients were in a state of encephalic death (Table 1). Analysis of the epidemiological characteristics of the patients in EME revealed (Table 2) an average age of 34 ± 15.6 years, with a sex ratio of seven men to one woman, in the presence of a medical history in 35.71% of cases, the average Glasgow score was 5.63 ± 0.324, in the presence of pupillary anomalies such as anisocoria in 28.57% and mydriasis in 21.42%. The diagnosis of brain death was clinical in 100% of cases, with paraclinical confirmation by transcranial doppler in 100% of cases. In our study, the mean time to transition to EME was 3 ± 1.23 (days) with a 95% CI [1.77- 4.23] (Table 3), and graft resuscitation was proposed without limiting care for brain- dead donors, Analysis of the availability of the resources required for the management of a potential donor in a state of brain death revealed the presence of monitoring, equipment, fluids and medicines required for donor surveillance, with the exception of the EEG machine for confirming the diagnosis of EME and desmopressin for the treatment of diabetes insipidus.

**Table 1: Incidence of brain death**

| | |
|---|---|
| Number of serious head injuries | 175 |
| Number of brain-dead donors | 28 |
| Incidence of brain death | 16% |

**Table 2: Epidemiological characteristics of MCTs that have progressed to ME**

| | **Number of employees (n)** | **The results** |
|---|---|---|
| Age | 28 | 34±15.6 years |
| Gender<br>-Men<br>-Woman | <br>24<br>4 | <br>7h/1F |
| Medical history<br>-Hypertension<br>-Diabetes | 10<br>6<br>5 | 35 ,71%<br>60%<br>50% |
| Average Glasgow score | 28 | 5,63 ± 0 ,324 |
| Status of wards<br>-Isocore<br>-Anisocoria<br>-Mydriasis | <br>14<br>8<br>6 | <br>50%<br>28,57%<br>21,42% |

**Table 3: Average time to onset of brain death and duration of resuscitation**

| | **The results** |
|---|---|
| Average time to EME (days) | 3 ± 1.23 IC 95% [1.77- 4.23] |
| Average resuscitation time (h) | 44.60±8.79 IC 95% [35.81 - 53.39] |

**Table 4: Resources required for the management of a potential donor in a state of brain death**

| | **Monitoring** | **Devices** | **Solutions and medicines** |
|---|---|---|---|
| **Available at** | Electrocardioscope<br>Pulse oximetry<br>Deep venous access<br>Central temperature<br>Catheterisation of the radial artery | Ultrasound<br>Blood gases<br>Fibroscope | Crystalloids or colloids<br>Noradrenaline<br>Dobutamine<br>Corticoids |
| **Not available** | | - EEG | - Desmopressin |

**Table 5: Paraclinical investigations essential for donor management in EME**

| **Availability** | **Biology** | **Radiological** | **Bacteriological** | **Serological and immunological** |
|---|---|---|---|---|
| **Yes** | -SNSF<br>-TP, TCA<br>-fibrinogen<br>-platelets<br>- D-Dimer Soluble complexes<br>- Liver check-up<br>- Renal check-up | -Teletorax<br>- Scanner Thoracic<br>-Scanner abdominal<br>-abdominal ultrasound | -Blood culture<br>-Uroculture<br>-Bronchial sampling | -HIV<br>-HCV or HBV |

| Availability | Biology | Radiological | Bacteriological | Serological and immunological |
|---|---|---|---|---|
| | -CPK mb<br>-Troponin IC<br>-BNP<br>-blood ionogram<br>- Lactates | | | |
| **NO** | - factor V<br>- urine ionogram | | | -Active tuberculosis<br>- Syphilis<br>-ESB<br>-HLA typing<br>-Cross-matches |

# DISCUSSION

The incidence of MTE varies from one study to another (Table 6). It depends essentially on the location of the study, with a high rate in neuro-resuscitation departments, but also on the type of study.

**Table 6: Incidence of MEE according to different studies**

| Authors | Year | The percentage of TCGs in EMEs |
|---|---|---|
| Petty *et al*., [5] | 1990 | 42% |
| The biomedicine agency [6] | 2000 | 24% |
| Sanchez-Olmedo [7] | 2005 | 14,6% |
| Our study | 2017 | 16 % |

Concerning the time to onset of EME and the duration of graft resuscitation, Leg *et al*., in 2013 [8] reported that the time elapsed between brain injury and the presence of absolute signs of coma is variable, but relatively short (24 hours to 5 days) and that the duration of EME maintained by resuscitation treatment does not exceed a few days before definitive cardiac arrest (48 hours to 130 hours). We agree with these authors concerning the delay between the onset of brain death and the duration of graft resuscitation. Brain death is clinically evoked by the presence of a non-reactive coma (Glasgow score 3), abolition of brainstem reflexes and spontaneous ventilation. The legal recognition of the declaration of brain death varies from country to country (Table 7).

**Table 7: International regulations on the declaration of encephalic death according to each country [5]**

| Country | International regulations on the declaration of brain death |
|---|---|
| **Spain** | Clinical criteria + 2 EEG, or angiography or transcranial doppler or evoked potential |
| **France** | Clinical criteria + 2 EEGs or angiography |
| **United Kingdom** | Clinical criteria |
| **Algeria** | Clinical criteria + 2 EEG |

In Algeria, transcranial Doppler has no medicolegal value in the declaration of the state of death, although numerous studies have validated the use of transcranial Doppler in the diagnosis of the state of encephalic death. The first consensus on the use of TCD in brain death, published in 1998, highlighted the value of this technique in the presence of sedatives preventing the performance of an EEG for the diagnosis of brain death [10]. Prior to this consensus, Newell et al in 1989 [11] , in a study of 12 MCTs, in the presence of clinical signs of encephalic death, found that the recording of a pathognomonic Doppler, in the form of an oscillating flow in the two sylvian arteries, corresponded to the abolition of cerebral blood flow measured by isotopic method. These authors concluded that transcranial Doppler is a technique used to easily assess the cessation of cerebral circulation.

Although TCD has no medicolegal value in declaring a state of encephalic death, it can be used to determine the best time to carry out an examination with medicolegal value. It would be pointless to carry out an angiography if a flow was detected on DTC; conversely, the presence of a symmetrical pendular flow would prompt an examination [12]. It also reduces the risk of kidney graft loss, due to patient movement and the quantity of contrast product injected. However, there must be a 6-hour delay between the transcranial Doppler and the angioscanner. In 2005, the recommendations of the Sfar/SRLF/Agence de la Biomédecine conference of experts [13] classified DTC as a tool that can be used to initiate the regulatory procedures for confirming ME without delay, and can therefore shorten the time between death and harvesting.

Diagnosis of the state of encephalic death is currently possible, essentially in neuro- resuscitation departments, but unfortunately it is not always possible to obtain grafts. In France, only 50% of the 3,200 EME cases detected in five years result in organ procurement

[14]. The absence of organ procurement in all situations where the patient has been declared brain dead is linked, on the one hand, to the donor's refusal to consent to organ procurement, expressed either during his lifetime or by his family after his death, the presence of medical contraindications and, on the other hand, to the failure of resuscitation to allow organ procurement to take place. While obtaining the donor's family's agreement is the objective of hospital coordination, resuscitating the donor to maintain organ perfusion and evaluating the grafts to guarantee their quality are the responsibility of the intensive care physician in charge of the potential donor. To carry out this task, the intensive care physician needs a suitable structure with monitoring and equipment, as well as therapeutic resources and biological, radiological, bacteriological and immunological investigations.

In our study we carried out a simulation to determine whether the management of this potential donor is possible at our level, if multi-organ retrieval is envisaged. We detected twenty-eight potential donors in EME, and analysis of the conditions in which they occurred showed that: The therapeutic objectives recommended by experts [15] to ensure haemodynamic stability, allowing the donor to be resuscitated, are easily controlled using the monitoring available in our department. The management of hypovolaemia secondary to diabetes insipidus must be carried out early and includes replacement treatment with intravenous desmopressin depending on the diuresis, and if necessary, compensation of the diuresis with a solution adapted to the blood osmolarity. In the absence of desmopressin, we find ourselves obliged to maintain filling, which is harmful for the lung if lung sampling is envisaged. Disturbances in haemostasis are frequent in ME, and the aim of their management is to maintain at least the following thresholds: platelets > 50 G/l, fibrinogen > 1 g/l, PT > 40% and aPTT ratio < 1.5. These objectives are generally achieved, because on the one hand they are similar to those recommended in the management of TCG, and on the other hand the biological monitoring enabling these objectives to be achieved is available to us.

In order to detect any colonisation or infection, a bacteriological investigation is carried out as soon as our patients are admitted to the intensive care unit; it is repeated secondarily as soon as an infectious syndrome appears. In our study, the time to onset of EME was 3±1.08 days, which means that the patient's ecology has been identified and probabilistic antibiotic therapy can be introduced if an infectious syndrome develops.

In our study, the presence of an infectious syndrome is not a barrier to sampling t, as its presence does not contraindicate sampling if the pathogen is isolated and effective treatment is instituted for a period of at least 24 to 48 hours. In our study, the duration of resuscitation was 44.60 ±18.71 hours.

The medical contraindications to sampling are the presence of a proven or metastatic cancer, and the regulatory contraindications are the presence of viral infections such as viral hepatitis, AIDS, syphilis and BSE. In our study, medical contraindications are eliminated as soon as donors are admitted, as a full radiological examination is carried out as part of a TCG lesion assessment. Determination of graft function requires a clinical and paraclinical evaluation by carrying out the necessary investigations for each organ [14]. Medical contraindications to harvesting are the presence of a proven or metastatic cancer, and regulatory contraindications are the presence of viral infections such as viral hepatitis, AIDS, syphilis and BSE. In our study, medical contraindications were eliminated as soon as the donors were admitted, as a full radiological examination was carried out as part of the TCG lesion assessment.

For regulatory contraindications, immunological and serological samples are not available in our establishment, but can be taken at another hospital if the sample is really envisaged.

All the biological and radiological investigations needed to assess graft quality are available to us, with the exception of coronography, which is not essential in our study, given the average age of our patients.

## CONCLUSION

Encephalic death is an unfavourable outcome for patients with severe cranial trauma, and this donor is an essential solution to the shortage of grafts. Graft resuscitation is essential to guarantee the success of the transplant, which requires the necessary resources to be available.

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