Turk J Intensive Care
DOI: 10.4274/tybd.galenos.2019.43255

ORIGINAL RESEARCH / *ÖZGÜN ARAŞTIRMA*

Çağatay Erman Öztürk,
Mehtap Pehlivanlar Küçük,
Selin Eyüpoğlu,
Ümmügülsüm Yüksel,
Fatma Ülger

Evaluation of Organ Donation Rates in Patients with Anticipated Imminent Brain Death

Yaklaşan Beyin Ölümü Beklenen Hastalarda Organ Bağış Hızlarının Değerlendirilmesi

Received/Geliş Tarihi : 02.09.2019
Accepted/Kabul Tarihi : 21.10.2019

Çağatay Erman Öztürk
University of Health Sciences, Samsun Training and Research Hospital, Clinic of Intensive Care Medicine, Samsun, Turkey

Mehtap Pehlivanlar Küçük
Karadeniz Technical University Faculty of Medicine, Department of Chest Diseases, Division of Intensive Care Medicine, Trabzon, Turkey

Selin Eyüpoğlu
University of Health Sciences, Prof. Dr. A. İlhan Özdemir Training and Research Hospital, Department of Anesthesiology and Reanimation, Division of Intensive Care Medicine, Giresun, Turkey

Ümmügülsüm Yüksel
Tokat State Hospital, Clinic of Intensive Care Medicine, Tokat, Turkey

Fatma Ülger
Ondokuz Mayıs University Faculty of Medicine, Department of Anesthesiology and Reanimation, Division of Intensive Care Medicine, Samsun, Turkey

Mehtap Pehlivanlar Küçük MD (✉),
Karadeniz Technical University Faculty of Medicine, Department of Chest Diseases, Division of Intensive Care Medicine, Trabzon, Turkey

E-mail : mehtap_phlvnlr@hotmail.com
Phone : +90 505 242 44 90
ORCID ID : orcid.org/0000-0003-2247-4074

ABSTRACT *Objective:* The aim of this study was to investigate the progression of brain death in close follow-up of comatose patients in intensive care unit, to reveal the data on epidemiological and clinical characteristics of brain death diagnosis process and the importance of timing of different stages of current procedures.
Materials and Methods: This study was planned as a single-center, prospective, cross-sectional study. Patients who were treated in ICU between 2015-2017 and who were diagnosed as GCS <8 without sedation were included in the study.
Results: Of the 79 patients diagnosed with brain death, 34 (43%) of their families provided consent for organ donation. However, only 26 (32.9%) of these patients actually became donors. The group that consented for organ donation had a significantly shorter time period between the declaration of brain death and the interview with the patient families about organ donation (median 12.5 minutes, 5-60 minutes) than the group that did not consent for organ donation (median 30 minutes, 2-60 minutes) (p=0.019).
Conclusion: We believe that it is possible to increase organ donation rates by carefully monitoring the patients with low coma score as they progress to brain death in intensive care units, providing detailed information to families and conducting organ donation interview with the family as soon as possible after brain death notification.
Keywords: Brain Death, Declaration, Intensive Care Unit, Organ Donation, Turkey

ÖZ *Amaç:* Bu çalışmada; yoğun bakımda izlenen komatöz hastaların yakın takibi ile beyin ölümüne gidiş sürecinin araştırılması, beyin ölümü tanı sürecindeki epidemiyolojik ve klinik özellikler, mevcut prosedürlerin farklı aşamalarındaki zamanlamanın önemi hakkında verilerin ortaya konulması amaçlanmıştır.
Gereç ve Yöntem: Bu çalışma tek merkezli, prospektif, kesitsel bir çalışma olarak planlanmıştır, 2015-2017 tarihleri arasında Yoğun bakımda tedavi gören, sedasyon almaksızın nörolojik muayenesinde GKS<8 olarak tespit edilen hastalar çalışmaya dahil edilmiştir.
Bulgular: Beyin ölümü tanısı alan 79 hastadan 34'ünün (% 43) ailesi organ bağışı için onay verebileceğini belirtti. Ancak, bu hastaların sadece 26'sı (% 32,9) gerçekten bağışçı oldu. Organ bağışını onaylanan grupta, beyin ölümü beyanıyla aile ile organ bağışı hakkında görüşme süresi [medyan 12.5 (5-60) dakika], organ bağışına izin vermeyen gruba göre daha kısa bir süreye sahipti [medyan 30 (2-60) dakika] (p = 0.019).
Sonuç: Yoğun bakım ünitelerinde beyin ölümüne ilerlerken koma skoru düşük olan hastaların dikkatle izlenerek, ailelere ayrıntılı bilgi verilmesinin ve aile ile organ bağışı görüşmesinin beyin ölümü bildiriminden sonra en kısa sürede yapılmasının organ bağışı oranları arttırabileceği düşüncesindeyiz.
Anahtar Kelimeler: Beyin ölümü, Deklerasyon, Organ bağısı, Türkiye, Yoğun bakım

Introduction

Currently, organ transplantation is the only effective treatment for end-stage organ failure. There are thousands of patients, both in Turkey and worldwide, who are waiting for transplantation due to end-stage organ failure.(1) Such patients are increasing in number, and yet, there are a limited number of organs available for transplantation. Recently, there have been advances in medical knowledge and technologies that have contributed to the reduction of mortality rates in intensive care units (ICUs). Intensivists must first and foremost treat their patients, but they can also identify potential organ donor candidates, and may contribute to the organ pool by applying advanced donor care strategies.(2) The first step in organ procurement is the identification of potential organ donor candidates, and because of this, the concept of brain death (BD) is quite important.(3) Patients who have a low Glasgow Coma Score (GCS) either at the time of ICU admission or during follow-up should be carefully monitored with regards to the possibility that they might be a potential organ donor. GCS is a good indicator of neurological state and can be used to monitor patients with destructive brain damage that may result in brain death.(4) The ICU team responsible for patient treatment also plays an important role in the diagnosis of brain death, and is responsible for caring for potential organ donors, monitoring the effective use of ICU beds, and the termination of treatment in a timely manner.(5, 6) Because potential organ donors need to undergo organ-saving treatments as soon as possible, the ICU care team should be effective and timely when making a diagnosis of brain death.(7)

There are a limited number of studies related to the follow-up of comatose patients in association with brain death and the organ donation process.(8-10) Although several clinics have published BD reports,(11) ICUs remain the major contributor to the organ pool, as they are best able to follow-up with patients with low GCS. The current study closely monitored comatose ICU patients in order to investigate their progression to brain death. In addition, the current study revealed epidemiological and clinical properties that are important in monitoring brain death as well as the importance of timing during various stages of existing procedures in the ICU.

Materials and Methods

Study Design

Following approval from the ethics committee (issued 2016/134), this study was conducted in the Tertiary Care Adult General Intensive Care Unit of our hospital between July 1st 2015 and December 31st 2017. This study was designed as a single-center, prospective, and cross-sectional study. Patients were included in the study if they were admitted to the ICU and had a GCS<8 in the absence of sedation. Study exclusion criteria were the administration of sedatives, GCS≥8, and duration of ICU stay <48 hours.

Study Patients

GCS was assessed via neurological examination and all patients with a GCS<8 either at the time of admission or during their ICU stays were included in the study. The following information was recorded for each enrolled patient: Primary diagnoses, demographic data, GCS on the first day of ICU admission, Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sequential Organ Failure Assessment (SOFA) scores, time elapsed until GCS deteriorated to 3, time between GCS of 3 and diagnosis of BD, complications that developed following BD, time between declaration of BD and approaching family about organ donation, time until cardiac arrest in the absence of organ donation, and time until organ retrieval (for those donating organs). Coma levels were monitored via daily GCS assessment.

Statistical Analysis

All data analyses were performed using IBM SPSS V23. The normality of the data was assessed with the Shapiro Wilk test. Comparisons of non-normally distributed numerical data were made with the non-parametric Mann Whitney U test. Comparisons of categorical data were made with chi-square test. Numerical data were expressed as medians (min-max), while categorical data were expressed as frequencies (percentages). A ROC analysis was used to calculate the cut-off APACHE II and SOFA scores for GCS 3. Values of $P<0.05$ were considered significant.

Results

Patient Characteristics

Among the 3,407 patients who were admitted to the ICU during the study period, 241 met the defined criteria and were enrolled in the study (Figure 1). Of these patients, 143 (59.3%) were male and 98 (40.7%) were female. The mean patient age was 55.6 ± 19.2 years. Thirty-four (14.1%) of the patients had a history of cardiopulmonary arrest at the time of admission. The most frequent indication for ICU admission was subarachnoid hemorrhage (SAH) (74

(30.7%) cases), followed by intraparenchymal bleeding (51 (21.2%) cases) and traumatic brain injury (23 (9.5%) cases). Neurosurgical cases comprised the most common patient population (169 (70.1%) cases) (Tables 1 and 2).

Of the study patients, 54 (22.4%) were discharged to a relevant hospital ward or a palliative care center, while 187 (77.6%) died during their ICU stay ICU (Figure 1). The median number of days until discharge was 24 (5-89), while the median number of days until death was 6 (1-110). Of the patients with GCS<8 who died during their ICU stay, 79 (42.2%) were diagnosed with BD. The median age of the patients diagnosed with BD was 48 (14-85) years, and these patients were significantly younger than those who died without being diagnosed with BD (median age: 62 (19-97) years) (p<0.001). The time until death was 4 (2-17) days among patients diagnosed with BD, which was significantly shorter than those who died without a diagnosis of BD (8 (1-110) days) (p<0.001). This result reveals that patients diagnosed with BD have a significantly shorter ICU stay length. As confirmatory test for the diagnosis of BD, transcranial Doppler ultrasonography (TCD) was applied to 61 (77.2%) patients, and cerebral angiography was applied to 16 (20.3%) patients. The diagnosis of BD was made clinically in 2 (2.5%) patients.

Table 1. Characteristics of ICU patients based on their admitting clinics

Admitting Clinic	Number of patients admitted	Number of deceased patients	Number of discharged patients	Brain death	Number of donations
Neurosurgery	169	121	48	70	23
General Surgery	22	22	0	0	0
Internal Medicine	13	13	0	0	0
Emergency Department	13	10	3	5	2
Cardiology	7	6	1	2	1
Infectious Diseases	6	6	0	0	0
Chest Diseases	4	3	1	1	0
Thoracic Surgery	3	2	1	1	0
Orthopedics	2	2	0	0	0
Plastic Surgery	2	2	0	0	0
Total	241	187	54	79	26

Table 2. Diagnoses at admission, rate of Brain Death diagnosis, and donation rates of patients

Diagnosis	Number of patients n (%)	Patients diagnosed with brain death n (%)	Donation n (%)
Total	241(100)	79(100)	26 (100)
Subarachnoid hemorrhage	74 (30.7)	43 (54.5)	15 (57.6)
Intraparenchymal bleeding	51 (21.2)	15 (19.1)	2 (7.7)
Traumatic brain injury	23 (9.6)	7 (8.8)	5 (19.2)
Intracranial mass	19 (7.9)	5 (6.3)	0 (0)
Multiple trauma	16 (6.6)	4 (5)	2 (7.7)
Sepsis	13 (5.4)	0 (0)	0 (0)
Extensive abdominal surgery	13 (5.4)	0 (0)	0 (0)
Hematological malignancy	11 (4.5)	0 (0)	0 (0)
Pneumonia	7 (3.0)	0 (0)	0 (0)
Cardiac arrest	6 (2.5)	2 (2.5)	1 (3.9)
Near-drowning	5 (2.0)	3 (3.8)	1 (3.9)
Pulmonary embolism	2 (0.8)	0 (0)	0 (0)
Malignant arrhythmia	1 (0.4)	0 (0)	0 (0)

Statistical evaluation of patients with brain death

Of the 79 patients diagnosed with brain death, the departments that admitted the patient were neurosurgery (70 (88.6%) patients), emergency department (5 (6.3%) patients), cardiology (2 (3.4%) patients), and thoracic surgery (1 (1.7%) patient) (Table 1). Regarding the primary diagnosis at admission, 43 (54.4%) patients had SAH, 15 (19%) had intraparenchymal bleeding, and 7 (8.8%) had traumatic brain injury (Table 2). Of the patients with BD, 34 (43%) of their families provided consent for organ donation. However, only 26 (32.9%) of these patients actually became donors (the organs of 8 patients could not be used due to medical contraindications). For those patients whose families did not consent for organ donation, the time until cardiac arrest was a median of 6 (1-16) hours. For those patients whose families did consent for organ donation, the time until organ retrieval was a median of 7 (2-14) hours.

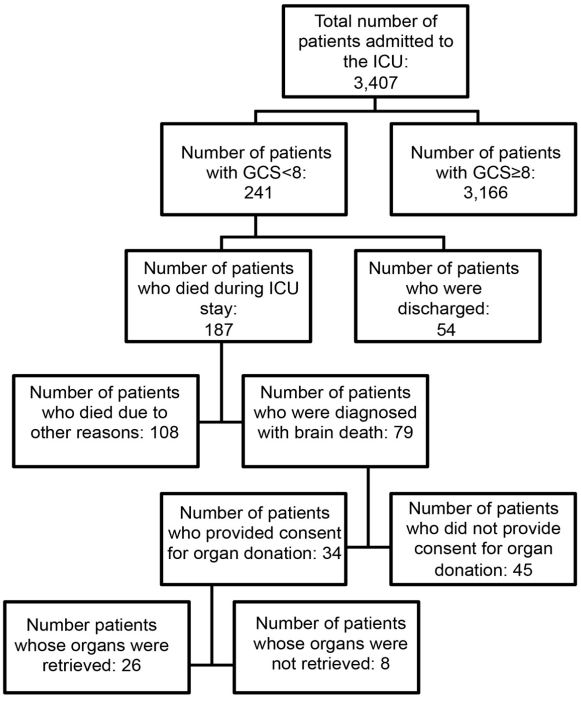

Figure 1. Follow-up progress of patients admitted to the ICU

At the time of ICU admission, GCS was significantly lower in those with brain death [median 4 (3-7)] compared to those who died without brain death [median 6 (3-7)] ($p<0.001$). Further, patients with brain death had significantly lower APACHE II scores at the time of ICU admission [median 18 (10-36)] compared to patients who died without BD [median 19 (8-32)] ($p=0.011$). However, there were no significant differences between patients with and without BD regarding SOFA scores assessed 24 hours after ICU admission [9 (4-17) vs. 9 (3-19), respectively] ($p=0.238$). The time between ICU admission and the time the GCS score decreased to 3 was 16 (0-336) hours in the group that consented for organ donation and 24 (0-192) hours in the group that did not consent for organ donation; this difference was not significant ($p=0.547$). There was also no difference between the time until the diagnosis of brain death following a GCS of 3 between those who did or did not consent to organ donation [38 (12-144) hours vs. 29 (7-102) hours, respectively; $p=0.112$)] (Table 3).

The group that consented for organ donation had a significantly shorter time period between the declaration of brain death and the interview with the patient families about organ donation [median 12.5 (5-60) minutes] than the group that did not consent for organ donation [median 30 (2-60) minutes] ($p=0.019$). Complications that developed in patients with brain death were diabetes insipidus (45 (56.9%) patients), hyperglycemia (33 (41.7%) patients), hypotension (49 (62%) patients), hypertension (19 (24%) patients), and arrhythmia (20 (25.3%) patients).

Different clinical decisions can be made after rejection of organ donation process. i) Withdrawal of all life supports including mechanical ventilator, ii) Partial withdrawal, gradual withdrawal, iii) Continuing all life support,In our study, we applied the partial reduction of support which we think is more effective in terms of decision change and adaptation to process in all cases where organ donation is rejected by the family. In our study, we applied the partial reduction of support in cases which organ donation is rejected by the family.

Table 3. Elapsed times with regard to organ donation

	Organ Donation		
	Yes	No	p
Time from GCS<8 until GCS=3 (hours)	16 (0-336)	24 (0-192)	0.507
Time from GCS=3 until BD (hours)	38 (12-144)	30 (7-102)	0.138

Data are shown as median (min-max) unless determined $p < 0.05$ is statistically significant

Discussion

Results of the present study revealed that the sooner the family was approached for organ donation following the declaration of brain death, the greater the organ donation rate.

However, a reasonable amount of time is required for the family to come to terms with the situation and to provide consent to organ donation following the declaration of brain death. One study from Turkey reported that the optimal time for this should be around thirty minutes, and that any length of time shorter than this may lead to suspicion and confusion on the part of the family, while any length of time longer than this might result in loss of the organ.(12) Our current results reveal greater organ donation rates for cases whose families were approached for organ donation in a short time (12.5 (5-60) minutes) following the declaration of brain death. This may be because the families in our study were informed of the process by detailed briefings during every stage of the clinical progress. As a general rule, it is not recommended to postpone the family interview following the declaration of brain death(13); however, different approaches may be required for families coming from different social backgrounds. Especially in studies in Turkey, it has been observed that complicated relationships among family members can either facilitate or hinder this process. These data suggest that greater success can be achieved if the transplantation coordinator provides support to both the intensivist and the family throughout the whole process, beginning at ICU admission.

In one study from Iran, it was noted that early detection of brain death provides the clinician extra time for both organ preservation and for convincing the family to consent to organ donation.(14) Initiation of organ-preserving treatment in cases with brain death is the most important determinant of donor compatibility following transplantation, and determines the number and quality of usable organs. The intensivist's foresight and clinical experience play important roles in this process. During the period of the current study, 26 patients diagnosed with brain death provided a total of 75 organs that were successfully transplanted (52 kidneys, 18 livers, 4 hearts, and 1 lung).

Several authors have proposed the concept of "imminent brain death" to describe patients with known catastrophic brain damage.(15) One study suggested that organ donation rates might increase if ICU physicians raised awareness about brain death and organ donation among the relatives of patients with GCS<5.(16) During routine ICU practice, family members are informed about brain death in detail after the patient's GCS decreases to 3, and physicians aim to make sure that the family completely understands the patient's present clinical condition. In the current study, the clinical findings of the patient group with GCS<8 were shared with their families, and a more comprehensive and explanatory briefing was given to family members of patients with rapidly deteriorating clinical findings or GCS=3, which facilitated their comprehension of the situation after the diagnosis and declaration of brain death.

Despite advanced treatment methods and monitoring techniques that have recently become available in the ICU, brain death remains an inevitable outcome in patients with destructive brain damage. Patients admitted to the ICU due to catastrophic neurological damage constitute the most important risk group for imminent brain death.(5) In Turkey, the classical profile of the organ donor with brain death is a young person with brain trauma due to a motor vehicle accident; however, this profile has changed as a result of the recent decrease in motor vehicle accidents. (4) In their multi-centered intensive care study, Bodi et al. reported that brain death occurred mostly in patients with hemorrhagic stroke and traumatic brain injury.(8) In another multi-centered intensive care study, Senouci et al. reported that cerebrovascular accident and trauma were the most frequent causes of brain death(10); a study from Spain noted similar results.(9) On the contrary, in a study from Holland, Kompanje et al. found that subarachnoid hemorrhage was the most common cause of brain death.(17) In our current study, subarachnoid and intraparenchymal hemorrhage and traumatic brain injury were the most common conditions in the etiology of brain death.

The diagnosis of brain death brings great liability in both clinical and judicial terms. In patients with brain death, further decisions should be made regarding the continuation of life support and the initiation of organ-preserving treatment for the possibility of organ donation.(9) At this stage, confirmatory tests are used to reduce the observation time and to effectively actuate the decision-making process. These tests may vary depending on the institution's available facilities and their applicability. Different countries may have different policies regarding the use of these tests. In Turkey, there is no obligation to conduct confirmatory tests, with the exception of certain clinical conditions (18), but clinical practices may vary depending on the clinician's decision.

In our current study, confirmatory tests were employed for nearly all brain death cases (n:77, 97.4%) in order to reduce the observation time and to confirm the diagnosis. Transcranial Doppler Ultrasonography (TCD) is a non-invasive test that can be performed repeatedly at the bed-side and does not require the administration of contrast material; it has a sensitivity of 91-99% and a specificity of 100%.(19, 20) It is often a convenient way to make the decision on brain death. For these reasons, TCD was preferred (77.2%) as a confirmatory test in our current study.

Cerebral circulatory arrest in brain death cases may cause many complications. While hypertension is frequently observed in the early stages following brain death, hypotension often develops at later stages.(21, 22) Cardiac arrhythmia, diabetes insipidus (DI), and hyperglycemia are also commonly seen in patients with brain death. These complications have varying prevalence rates in the literature. (23-29) In our current study, the most commonly observed complications in brain death cases were hypotension, DI, and at later stages, hyperglycemia. The severity of complications developing after brain death may be reduced by watchful care so that potential organ loss can be prevented. The rates of complications observed in our current study were relatively low compared to those in previously published studies. We believe that this is because we initiated the organ care process in the early period (following admission to the ICU), and because the clinicians in this study had a lot of experience in this subject.

Our current results indicate that the cases diagnosed with brain death during the study period represented 16.7% of all ICU mortalities, and 2.4% of all in-hospital mortalities. Senouci et al. reported that 11.7% of all ICU mortalities and 3.3% of all in-hospital mortalities were diagnosed with brain death.(10) Bodi et al. found the rates of brain death as 12.4% for all ICU mortalities and 2.3% for all in-hospital mortalities. (8) One systematic review from Spain reported that 13.1% of all ICU mortalities were diagnosed with brain death.(30) Unlike our current study, these previous studies had a multi-centered design. That we observed higher rate of brain death in proportion to all ICU mortalities when compared to these previous studies may be due to the fact that a great majority of our patient population was admitted by neurosurgery.

Possible options for cases for which organ donation consent is not obtained include withdrawal of all life-supporting measures, partial withdrawal of treatment with discontinuation of vasoactive drugs, gradual withdrawal of treatment, or continuation of the current treatment. Aside from some exceptional conditions, there is no ethical rationale for continuing treatment in cases of brain death, and it is not recommended, as it leads to the unnecessary and wasteful use of resources (9). In Turkey, there are clearly defined regulations for situations in which there is no consent for organ donation in cases with brain death (31). In Turkey, if the rejection of organ donation after brain death, the patient can be removed from life support without the permission of the family, that was published in the official newspaper (18). Accordingly, when brain death occurs without consent for organ donation, vasoactive drugs are discontinued, and ventilatory support may be minimized or removed. One multi-centered study from Spain reported the rate of treatment withdrawal as 75% in brain dead cases without organ donation consent, with the general practice being the withdrawal of all treatments, including ventilatory support (9). In our study, we applied the partial reduction of support in cases which organ donation is rejected by the family.

In cases with consent for organ donation, the retrieval, preservation, and distribution of organs require serious organization. This organization should be performed meticulously by hospital coordinators in unison with the National Coordination Center (NCC). In countries that traverse large, various geographical areas (e.g., Turkey), any flaws in the organization and the distance between transplantation centers can influence the time elapsed until organ retrieval. One study from Turkey found that the median time until organ retrieval after consent to organ donation was 7 hours.(26) In our current study, this time was 9 hours. The differences in these times may be explained by the extent of geographical distances, the distance between the transplantation center and the hospital where the study was conducted, and challenges faced by the transport team.

This study has some limitations. First, the majority of the patients included in this study were neurosurgery patients (70.1%). For this reason, we could not achieve homogeneity in the patient population with brain death. However, we could nevertheless infer which patient groups were more prevalent within this population. Another limitation was that this study was conducted in a single ICU. Comprehensive, multi-centered ICU studies on brain death and organ donation from Turkey are needed.

Conclusion

We believe that organ donation rates can be increased by careful monitoring of patients with low coma scores during progression to brain death in the ICU, providing the families with detailed briefings, and approaching the family for organ donation as soon as possible following declaration of brain death.

Ethic Commitess Aprovel: Ethic was approved (issued 2016/134) by the local committee.

Patients Consent: Families of patients have consented to publication of information about patients under the light of Declaration of Helsinki.

Author Contrubitions:

Surgical and Medical Interneviton: M.P.K., Ç.E.Ö. Consept: M.P.K., Ç.E.Ö., F.Ü. Desgin: M.P.K., Ç.E.Ö., F.Ü., Data collection: S.E., Ü.Y. Analyses and Comments: S.E., Ü.Y., Literatuure research: Ç.E.Ö., S.E., Ü.Y. Writer: Ç.E.Ö Revision: F.Ü., S.E., M.P.K., Ü.Y.

Conflicting Interests: Authors declare there is no Conflicting Interests

Fundings: Authors declare there is no fundings.

References

1. Harmanci Seren AK, Yavuz H. Numbers of Brain Deaths and Deceased Donors in Hospitals in Istanbul Region That Have Transplantation Units: A Retrospective Analysis Between the Years 2005 and 2015. Transplant Proc. 2017;49(3):392-5.
2. Citerio G, Cypel M, Dobb GJ, Dominguez-Gil B, Frontera JA, Greer DM, et al. Organ donation in adults: a critical care perspective. Intensive Care Med. 2016;42(3):305-15.
3. Halevy A, Brody B. Brain death: reconciling definitions, criteria, and tests. Ann Intern Med. 1993;119(6):519-25.
4. Kahveci E. Donör tespit sistemi ve klinik değerlendirme. İçinde:. Kahveci E, Bozoklar AC, Topçuoğlu MA, editors. Ankara: Kayıhan ajans; 2015.
5. Arsava EM, Topçuoğlu MA. Beyin ölümü tanısı: Klinik ve laboratuvar. İçinde:. Kahveci E, Bozoklar AC, Topçuoğlu MA, editors. Ankara: Kayıhan ajans; 2015.
6. Maciel CB, Greer DM. ICU Management of the Potential Organ Donor: State of the Art. Curr Neurol Neurosci Rep. 2016;16(9):86.
7. Pirat A, Zeyneloğlu P. Donör bakımı. İçinde:. Kahveci E, Bozoklar AC, Topçuoğlu MA, editors. Ankara: Kayıhan ajans; 2015.
8. Bodi MA, Pont T, Sandiumenge A, Oliver E, Gener J, Badia M, et al. Brain death organ donation potential and life support therapy limitation in neurocritical patients. Med Intensiva. 2015;39(6):337-44.
9. Escudero D, Valentin MO, Escalante JL, Sanmartin A, Perez-Basterrechea M, de Gea J, et al. Intensive care practices in brain death diagnosis and organ donation. Anaesthesia. 2015;70(10):1130-9.
10. Senouci K, Guerrini P, Diene E, Atinault A, Claquin J, Bonnet F, et al. A survey on patients admitted in severe coma: implications for brain death identification and organ donation. Intensive Care Med. 2004;30(1):38-44.
11. Aksoy İ, M. PK, Öztürk ÇE, Baydın A. Early detection of brain damage in emergency department and the organ donation process: a case series. The European Research Journal. 2018;Published online April 12, 2018.
12. Yücetin L. Aile ile görüşme ve izin alınması. İçinde: . Yücetin L, editor. Antalya2007.
13. Arslan A, Dilek A. Kadavradan organ bağışında aile algısı ve iletişim. Turk Neph Dial Transpl. 2017;26(2):147-53.
14. Sadegh Beigee F, Mohsenzadeh M, Shahryari S, Mojtabaee M. Role of More Active Identification of Brain-Dead Cases in Increasing Organ Donation. Exp Clin Transplant. 2017;15(Suppl 1):60-2.
15. de Groot YJ, Jansen NE, Bakker J, Kuiper MA, Aerdts S, Maas AI, et al. Imminent brain death: point of departure for potential heart-beating organ donor recognition. Intensive Care Med. 2010;36(9):1488-94.
16. Birtan D, Arslantas MK, Dincer PC, Altun GT, Bilgili B, Ucar FB, et al. Effect of Interviews Done by Intensive Care Physicians on Organ Donation. Transplant Proc. 2017;49(3):396-8.
17. Kompanje EJ, de Groot YJ, Bakker J. Is organ donation from brain dead donors reaching an inescapable and desirable nadir? Transplantation. 2011;91(11):1177-80.
18. Organ ve doku hizmetleri yönetmeliği, 28191 (01.02.2012).
19. Ekemen S. Beyin ölümü. Turkiye Klinikleri J Anest Reanim-Special Topics. 2009;2(2):1-7.
20. Ünal A, Dora B. Beyin ölümü tanısında destekleyici bir test olarak transkranial doppler ultrasonografi. Turkish Journal of Cerebrovascullar Diseases. 2012;18(3):49-59.
21. Bugge JF. Brain death and its implications for management of the potential organ donor. Acta Anaesthesiol Scand. 2009;53(10):1239-50.
22. DuBose J, Salim A. Aggressive organ donor management protocol. J Intensive Care Med. 2008;23(6):367-75.
23. Dosemeci L, Yilmaz M, Cengiz M, Dora B, Ramazanoglu A. Brain death and donor management in the intensive care unit: experiences over the last 3 years. Transplant Proc. 2004;36(1):20-1.
24. Dujardin KS, McCully RB, Wijdicks EF, Tazelaar HD, Seward JB, McGregor CG, et al. Myocardial dysfunction associated with brain death: clinical, echocardiographic, and pathologic features. J Heart Lung Transplant. 2001;20(3):350-7.
25. Gramm HJ, Meinhold H, Bickel U, Zimmermann J, von Hammerstein B, Keller F, et al. Acute endocrine failure after brain death? Transplantation. 1992;54(5):851-7.
26. Kıraklı C, Uçar ZZ, Anıl AB, Özbek İ. Yoğun bakımda beyin ölümü kesin tanı süresinin kısalmasının organ bağışı oranlarına etkisi Yoğun Bakım Derg. 2011;1(8):11.
27. Salim A, Martin M, Brown C, Rhee P, Demetriades D, Belzberg H. The effect of a protocol of aggressive donor management: Implications for the national organ donor shortage. J Trauma. 2006;61(2):429-33; discussion 33-5.
28. Smith M. Physiologic changes during brain stem death--lessons for management of the organ donor. J Heart Lung Transplant. 2004;23(9 Suppl):S217-22.
29. Wood KE, Becker BN, McCartney JG, D'Alessandro AM, Coursin DB. Care of the potential organ donor. N Engl J Med. 2004;351(26):2730-9.
30. Cuende N, Canon JF, Alonso M, Delagebasala CM, Sagredo E, Miranda B. [Quality assurance program in the process of donation and transplantation at the National Organization of Transplantations]. Nefrologia. 2001;21 Suppl 4:65-76.
31. Hakeri H. Tıp hukuku. 10 ed. Ankara: Seçkin yayıncılık; 2015. 370-84 p.