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Original Article / Özgün Araştırma

Retrospective Evaluation of Patients Diagnosed with Brain Death in the Intensive Care Unit: A 10-year Single Center Analysis

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Abstract

Aim: This study aimed to investigate the demographic characteristics, clinical features, timing of the diagnosis of brain death, and factors associated with organ donation in patients diagnosed as brain dead in the intensive care unit in the last decade.

Method: Between 01.01.2015-01.06.2024, the age, gender, intensive care unit hospitalization diagnoses, the day of intensive care unit hospitalization, blood groups, the number of patients diagnosed with brain death by years, the number of patients diagnosed with brain death, the number of patients who became donors, laboratory values on the day of intensive care unit hospitalization and the day of brain death diagnosis, the reasons why families did not accept organ donation were recorded from the patients' files and hospital information system.

Results: A total of 59 patients were included in the study. Of the patients, 32 (54.24%) were female and 27 (45.76%) were male. The age distribution of the patients was seven (11.86%) aged 0-17 years, 29 (49.15%) aged 18-64 years, and 23 (38.98%) aged 65 years and older. The most common intensive care unit hospitalization diagnoses were intracerebral hemorrhage (35.59%), subarachnoid hemorrhage (16.95%), and CVA (13.56%). Although brain death was diagnosed in 83.05% of the patients in the first seven days, it was diagnosed in an average of 4.81 days in all patients. When the laboratory values between the day of admission to the intensive care unit and the day of brain death were diagnosed, a statistically significant difference was found in Na+, Cl-, K+, AST, BUN, and creatinine values ($p<0.05$). There was no significant difference in ALT and INR values ($p>0.05$). Among the reasons for not accepting organ donation, familial reasons were the highest, with 79.66%.

Conclusion: In order to increase the number of organ donations, it is important to raise public awareness and increase the level of knowledge of families about organ donation. Patients with poor neurological prognosis with hospitalization diagnoses such as intracranial hemorrhage, CVA, and Post CPR should be closely monitored for brain death and potential donors.

Keywords: Brain death, Intensive care unit, Organ donation, Diagnosis, Rejection

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Yoğun Bakım Ünitesinde Beyin Ölümü Tanısı Alan Hastaların Retrospektif Olarak Değerlendirilmesi: 10 yıllık tek merkez analizi

Öz

Amaç: Bu çalışmada amacımız yoğun bakım ünitesinde son on yıldaki beyin ölümü tanısı konan hastaların demografik özelliklerini, klinik özelliklerini, beyin ölümü tanısının zamanlamasını ve organ bağışıyla ilişkili faktörleri incelemektir.

Yöntemler: 01.01.2015-01.06.2024 tarihleri arasında yoğun bakım ünitesinde beyin ölümü tanısı konulan hastaların yaş, cinsiyet, yoğun bakım yatış tanıları, beyin ölümü tanısının yoğun bakım yatışının kaçıncı günde konduğu, kan grupları, yıllara göre beyin ölümü tanısı konan hastaların sayısı, donör olan hasta sayısı, yoğun bakım ünitesine yatışındaki ve beyin ölümü tanısının konduğu gündeki laboratuvar değerleri, ailelerin organ bağışını kabul etmeme nedenleri hastaların dosyalarından ve hastane bilgi sisteminden alınarak kayıt edilmiştir.

Bulgular: Çalışmaya toplam 59 hasta dahil edilmiştir. Hastaların 32'si (%54,24) kadın 27'si (%45,76) erkektir. Hastaların yaş dağılımı 0-17 yaş arası 7 (%11,86), 18-64 yaş arası 29 (%49,15) ve 65 yaş ve üstü 23 (%38,98) hastadır.En sık yoğun bakım yatış tanıları intraserebral kanama (%35,59), subaraknoid kanama (%16,95) ve SVO (%13,56) dır. Hastaların % 83.05'inde ilk yedi günde beyin ölümü tanısı koymakla beraber tüm hastalarda ortalama 4.81 günde tanı konmuştur. Yoğun bakım ünitesine yatış günü ve beyin ölümü tanısı konulan gün arasındaki laboratuvar değerleri karşılaştırıldığında Na+, Cl-, K+, AST, BUN ve kreatinin değerlerinde istatistiksel olarak fark bulunmuştur($p<0.05$). ALT ve INR değerlerinde ise anlamlı bir fark bulunmamıştır($p>0.05$). Organ bağışını kabul etmeme nedenleri arasında ailevi nedenler %79,66 ile en yüksek orandadır.

Sonuç: Organ bağışı sayılarının artması için toplumun bilinçlendirilmesi ve ailelerin organ bağışı hakkındaki bilgi düzeylerinin artırılması önemlidir. İntrakraniyal kanama, SVO ve Post CPR gibi yatış tanıları olan nörolojik prognozu kötü seyreden hastalar beyin ölümü ve potansiyel donör olmaları açısından yakından takip edilmelidir.

Anahtar kelimeler: Beyin ölümü, Yoğun bakım ünitesi, Organ bağışı, Tanı, Red.

INTRODUCTION

Brain death is the irreversible loss of function of the brain stem and other parts of the brain and is a critical stage in the evaluation of patients as organ donors[1-3]. Developments in the field of transplantation and the number of patients waiting for transplantation are increasing day by day. Brain death has a very important place in increasing organ donation. Intensive care unit (ICU) practices are essential for the follow-up of potential donor patients, early and accurate diagnosis of brain death, obtaining family consent, and controlled and rapid progress of the organ harvesting process. Throughout this process, good donor care is also necessary for good transplantation, as evidenced in the literature[4,5].

This study aimed to investigate the demographic characteristics, clinical features, time of diagnosis of brain death, and factors associated with organ donation in patients diagnosed as brain dead in the intensive care unit during the last decade.

METHOD

The Diyarbakır GaziYaşargilTraining and Research Hospital's Ethics Committee (No: 61, Date: 10/05/2024) approved this retrospective study, and it was carried out in compliance with the Declaration of Helsinki. The study was conducted in Muş state hospital.The age, gender, diagnosis of brain death during ICU hospitalization, blood group, number of patients diagnosed with brain death by year, number of donors, laboratory values on the day of ICU hospitalization and the day of diagnosis of brain death, and the reasons for families' refusal to accept organ donation were documented from the patient files and hospital

information system between January 1, 2015, and June 1, 2024.

Statistical Analysis

The demographic data is given using descriptive statistics. To compare data from two measurement days for laboratory data, a test for normal distribution was initially run. For regularly distributed data, the mean ± standard deviation (SD) values were utilized, whereas for non-normally distributed variables, the median (minimum-maximum) values were employed. For normally distributed data, a paired t-test was employed; for non-normally distributed data, a Wilcoxon test was utilized. Statistics were deemed significant if $p<0.05$. The computations were performed using SPSS (version 22, SPSS Inc., Chicago, IL, USA).

RESULTS

The study comprised 59 patients in total. There were 27 (45.76%) males and thirty-two (54.24%) females. The patients' ages were distributed as follows: seven (11.86%) were in the 0–17 age group, 29 (49.15%) were in the 18–64 age group, and 23 (38.98%) were in the 65 and older age group. The most frequent diagnoses for patients admitted to the intensive care unit were CVA (13.56%), subarachnoid hemorrhage (16.95%), and intracerebral hemorrhage (35.59%) (Table I).

Brain death was diagnosed in the first seven days of ICU hospitalization in 83.05% of patients, between 8-13 days in 13.56%, and 14 days or later in 3.39%. The blood groups of the patients are presented in the Table (Table I).

Table I: Patients' demographic characteristics

Age (year)(n) (%)	**(mean ± SD)**	
0-177(11.86)	10.86 ± 3.98	
18-6429(49.15)	43.45 ± 14.73	
65 and over23(38.98)	73.83 ± 6.95	
Gender Female Male	**n (%)** 32 (54.24) 27 (45.76)	
Intensive care hospitalization diagnoses	n	%
Intracerebral hemorrhage	21	35.59
SAH	10	16.95
CVA (Hemorrhagic/Ischemic)	8	13.56
Gunshot wound/Suicide	5	8.47
Suicide hanging	1	1.69
Post CPR/ Hypoxic brain	7	11.86
Non-vehicletrafficaccident/ Fall fromheight	6	10.17
Drowning in Water	1	1.69
On theday of intensivecarehospitalization, braindeathwasdiagnosed	n	%
0-7 days	49	83.05
8-13 days	8	13.56
14 andmoredays	2	3.39
Blood groups	n	%
ARh +	23	38.98
BRh +	10	23.73
ABRh +	4	16.95
0Rh +	14	23.73
ARh -	3	5.08
BRh -	1	1.69
ABRh -	2	3.39
0Rh -	2	3.39

**SAH: Subarachnoid hemorrhage, CVA: Cerebrovascular accident, CPR: Cardiopulmonary resuscitation, SD: Standard deviation, n: Number of patients, %: Percentage*

When evaluating the numbers of brain deaths and donors over the years, it is observed that the number of patients diagnosed with brain death from 2015 to 2024 has varied but generally shows an increasing trend. While 3 cases of brain death were identified in 2015, this number increased to 9 in 2023. Of the total 59 patients diagnosed with brain death, only 2 (3.39%) became donors (Figure 1).

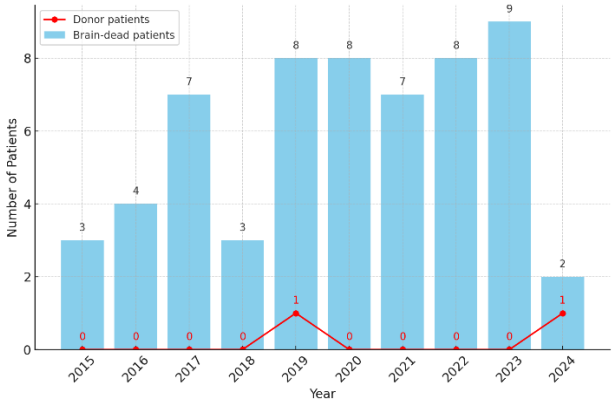

Figure I. Number of brain deaths and donors by year

Among the reasons for not accepting organ donation, familial reasons were the highest, with 79.66%. Religious reasons were 11.86%, will was 5.08%, and concern that body integrity would be impaired was 3.39% (Table II).

Table II: Reasons for not accepting organ donation

	n	%
Familyreasons	47	79.66
Religiousreasons	7	11.86
Because of thewill	3	5.08
Concernthat body integritywill be compromised	2	3.39

** n: Number of patients, %: Percentage*

When comparing laboratory values between the day of ICU admission and the day of brain death diagnosis, a statistically significant difference was found for Na+, Cl-, K+, AST, BUN, and creatinine levels ($p<0.05$). There was no significant difference in ALT and INR (Table III).

Table III: Laboratory values of patients diagnosed with brain death during intensive care unit hospitalization and on the day of diagnosis of brain death

	ICU hospitalizationday	Brain deathdiagnosisday	*p*-value
Na^+(mm/L)	141.2±8.21	155.1±7.89	0.003
Cl^-(mm/L)	106.5±9.49	118.5±12.32	0.004
K^+(mm/L)	3.65±0.65	4.23±0.34	0.03
ALT(U/L)	44(6-980)	47(5-430)	0.124
AST(U/L)	40(10-1120)	48(6-740)	0.014
BUN(mg/dL)	19.2(5.2-72.6)	12.4(3.1-59)	0.032
Creatine (mg/dL)	0.71(0.49-3.01)	0.52(0.40-4.21)	0.031
INR	1.09(0.71-3.32)	1.13(0.92-4.73)	0.198

**Median (minimum-maximum) values were taken for non-normally distributed variables, and mean and SD values were taken for normally distributed variables.*

Na: Sodium, Cl: Klor, K: Potassium, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, BUN: Blood urea nitrogen, INR: International normalized ratio, SD: Standard deviation, p< 0.05 was considered statistically significant

DISCUSSION

As in all countries, the number of patients waiting for organ transplantation is increasing in our country. Therefore, the importance of cadaveric organ transplantation is increasing. It is very important to diagnose brain death in patients who are potential donor candidates for cadaveric organ transplantation[1,5-7].

Organ donation is a hope for many patients with organ failure. Although organ transplantation from living donors is well established, organ donation from brain-dead or near-brain-dead donors is increasing with increasing awareness. The critical care physician may be involved in the diagnosis and documentation of brain death and in providing the intensive care necessary for this donor[4]. The intensivist should have a thorough understanding of the pathophysiology and management of organ donation and transplantation. Organs donated after brain death can potentially give "life" to eight people. In order to maximize the benefit and preservation of donated organs, the anesthesia and resuscitation specialist and the intensive care specialist have a very important role to play in the best possible preservation of such donated organs[5].

In most of the studies conducted in our country, the number of male patients diagnosed with brain death was found to be higher[8-11]. In the study conducted by Onur et al., the rate of female patients was found to be 52.3%[12]. In our study, the proportion of female patients was higher.

In the study of Özlem et al., it was found that intracranial hemorrhage was 47.33%, post-cardiopulmonary resuscitation was 3.38%, and drowning was 1.93% among the causes of brain death[9]. In Murat et al. study, intracranial hemorrhage was found to be 47%, and traumatic hemorrhage was found to be 21%[11]. In Savaş et al. study, intracranial hemorrhage was the first cause of brain death10. Trauma ranked first in the study of Battal et al., and SAH ranked first in the study of Karasu et al.[13,14]. In our study, intracerebral hemorrhage ranked first with 35.59%, SAH ranked second with 16.95%, and CVA ranked third with 13.56%.

In a study conducted in Portugal, the most common blood group was A Rh+[15]. In a study by Özlem et al., the most common blood group was 0 Rh+ (41.9%)[16]. In 2 other studies conducted in Turkey, blood group A was found to be the most common[6,17]. In our study, the most common blood group was A.

Karasu et al. diagnosed brain death in 86% of patients within the first seven days[14]. Battal et al. showed the diagnosis of brain death to be 106.2 hours[13]. Mehmet et al. found this period to be 144 hours in their study[8]. Murat et al. diagnosed brain death in 69.69% of patients in the first seven days[11]. In our study, brain death was diagnosed in 83.05% of patients in the first seven days, and the mean time to diagnosis was 4.81 days for all patients. It is crucial to diagnose brain death in a timely manner, both for the relatives of the patient and in case of potential organ donation. Every passing minute is critical, so we believe it is beneficial to declare brain death promptly.

Battal et al. analyzed five-year data and found that 19 (29%) of 62 brain deaths were donors[13]. In the study by Karasu et al., eight-year data were analyzed, and it was observed that 27 (34.2%) of 79 brain deaths were donors[14]. In a study conducted by Yasin et al., 57 brain deaths were diagnosed in ten-year data, and 19 (33.3%) were found to be donors[6]. In another study, 41 patients were diagnosed with brain death in eight years, and six (14.6%) patients became donors[7]. In our study, 59 patients were diagnosed with brain death in a 10-year period, and only two patients became donors. We attributed the most important reason for this situation to the lack of the same physicians in intensive care units and the lack of sufficient knowledge about organ donation among the people living in our province.

In the study conducted by Seda et al.the laboratory data on the day of hospitalization and the day of brain death diagnosis were analyzed, AST and ALT values were higher on the day of hospitalization, but there was no statistically significant difference between the two days. In the same study, a significant difference ($p<0.05$) was observed between creatine, Na+, K+, and Cl- levels when comparing the laboratory data of patients on the day of ICU admission and the day of brain death diagnosis[18]. Similarly, in our study, a statistically significant difference was observed in creatinine, Na+, K+, Cl-, AST, and BUN levels between the two days. We believe that the elevated Na+ levels occurred secondary to excessive fluid loss due to the development of Diabetes Insipidus following brain death.

In our study, an apnea test could not be performed in 16 patients due to unstable hemodynamics, and the diagnosis was made using cranial computed tomography (CT) angiography. In all 59 patients, the diagnosis of brain death was made using cranial CT angiography.

Many studies have been conducted on the refusal of organ donation in family interviews for organ transplantation. Families have very different levels of education, religious beliefs, and knowledge about organ donation. Differences are observed even in different cities of the same country[19,20]. In the studies conducted in our country, religious reasons were found in the first place among the reasons for organ donation refusal in family interviews after brain death. In the study of Mehmet et al., the first two reasons for the refusal of organ donation were familial reasons and the undesirability of disruption of body integrity[8]. A study conducted by Ömer et al. reported that the reasons for refusal were religious beliefs (41.3%) and undesirability of disruption of body integrity (37.3%)[21]. In our study, the first reason for organ rejection was family reasons (79.66%), the second reason was religious reasons (11.86%), then will (5.08%), and the last reason was not want to disrupt the integrity of the body (3.39%). We think that the rejection rates will decrease with the increase in the level of knowledge of the people living in the country about organ donation and more experience of the transplant coordinator in family interviews.

Limitations

The most important limitations of this study are its retrospective nature and insufficient patient heterogeneity due to its single center.

CONCLUSION

Demographic characteristics and laboratory values of patients diagnosed as brain dead in the ICU are important factors influencing organ donation. To increase the number of organ donations, it is important to increase public awareness and family knowledge about organ donation. Patients with poor neurological prognosis and hospital diagnoses such as intracranial hemorrhage, CVA, and post-CPR should be closely monitored for brain death and potential donors.

Ethics Committee Approval: The Ethics Commission of Diyarbakır Gazi Yaşargil Training and Research Hospital authorized the study and waived the necessity for informed consent (No:61 Date: 10/05/2024) The present manuscript was conducted in line with the provisions of the Declaration of Helsinki (2013).

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