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The effect of pre-transplant and transplant care on organ quality: a cross-sectional study

Original article

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Abstract: **Objective:** To determine the effect of management before and during transplantation on the quality of donated organs. Improvement of preservation methods in cases involving brain death will lead to more effective organ procurement.
Methods: Data were collected from the 226 brain death cases enrolled in the 12-month study period. All cases, patients with a Glasgow Coma Scale (GCS) score of 3 points, appropriate age, and having medical indications for organ donation, were considered to confirm the criteria of brain death. Transplant outcome data were obtained from the transplant centers.
Results: The age of the deceased ranged between 1 year and 68 years, with a mean ± SD of 39.54 ± 17.28 years. There was no significant difference between the quality of organs regarding blood group and cause of brain death ($P > 0.05$). However, there was a significant difference in the quality of organs regarding age, body mass index (BMI), and gender. There was a significant difference between the level of urea at admission time and procurement time ($P < 0.001$), as well as between creatinine level at admission time and procurement time ($P < 0.001$). There was also a significant difference between aspartate aminotransferase (AST) at admission time and procurement time ($P < 0.001$), and between alanine aminotransferase (ALT) at admission time and procurement time ($P < 0.001$).
Conclusions: Transplant outcomes using older donor livers and kidneys were comparable to those using younger or male donors. These findings provide further evidence that decision-making about organ quality is influenced by age and gender and emphasize the importance of transparency in organ acceptance practices.

Keywords: *kidney • liver • organ quality • transplantation • transplant care*

1. Introduction

Brain death is defined as an irreversible loss due to the failure of whole brain and brain stem functions. The major cause of brain death in Iran has been cerebrovascular accidents (CVA). The next most common cause is head trauma, especially in young people aged 20–40 years.[1]

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There are far more patients on waiting lists than there are available organs for transplant.2 Due to the lack of donated organs in Iran, every 2 h a patient on the waiting list dies due to the lack of a transplanted organ. Based on the studies, the number of patients on waiting lists is growing due to chronic diseases.[3–5] Given the lack of donated organs, transplant teams have been searching for possibilities to further expand the donor pool.[6]

Improving the quality of organs after brain death, in preparation for transplantation, is a crucial step in increasing the number of organs available.[7] Brain death involves a major pressure on the body that is associated with a significant inflammatory response.[8,9] Improving the quality of organs after brain death involves optimization before transplantation.[7] Transplantation is a surgical procedure requiring the highest level of scientific standards.[10] Transplant teams play an important role in the management of brain death cases through detecting potential donors, confirming brain death, and providing appropriate preservation.[11,12] Based on the precise standards for donor evaluations before any donation, the transplant team may be required to follow protocols to conduct a donor screening.[13] Several studies have revealed factors that should be considered before organ procurement at the time of brain death. These factors include age, history of malignancy, active and untreated current opportunistic infection, mental illness, drug abuse, severe liver or lung disease, and ischemic heart disease.[13]

Due to the complex nature of organ donation, the process of caring for brain death cases has various challenging dimensions, not all of which have been thoroughly explored and studied.[14] Donor management is one of the challenges of organ donation coordinators. To increase the quantity and quality of donatable organs, organ management must be considered on 2 levels: preserving the body before procurement and preserving the organs after procurement and before transplantation. Improving preservation methods in brain death will lead to more suitable organ procurement.[15] The effect of transplanted organ quality on transplant results cannot be ignored.[16]

The first stage in improving the quality of donated organs is brain death preservation. To obtain the desired result from a transplant, all donors must be preserved in their normal physiological conditions until the time of organ procurement.[17] The second stage of organ preservation is the preservation of the organ from the time it is removed from the body of the donor until the time it is transplanted to the patient. Normally, this step is done at 3 levels: cell, tissue, and organ.[18] The rate of organ donation in Iran is higher than that of other Asian countries, reaching 12.57 in 2023. In contrast, countries like Spain and the United States, which hold the first and second positions in global organ donation, recorded rates of 49.38 and 48.04, respectively. This indicates that Iran still has a long way to go to reach the levels of these countries.[19]

As a result, it can be stated that a successful organ transplant requires an efficient system for organ preparation and management.[20] Experience has shown that countries that have developed organ quality control have had a reasonable increase in the number of actual donors.[16,20,21]

Therefore, this study was planned and implemented to determining the effect of care before and during transplantation on the quality of donated organs.

2. Methods

2.1. Study design

Data from all 226 brain death cases enrolled in the Tehran University of Medical Sciences in 12 months, as well as that of those who became donors, were retrospectively analyzed.

2.2. Data collection

All cases patients with a Glasgow Coma Scale (GCS) score of 3 points, of appropriate age, and with medical indications for organ donation were considered to check the criteria of brain death. The local transplant coordinator collected donor data by completing a study checklist at the time of or immediately following brain death. This checklist recorded the following information: age, gender, cause of brain death, underlying disease, clinical tests, and the condition of the patient. Transplant outcome data were obtained from the transplant centers. The quality of the transplanted organ was checked by the transplant surgeon and then the data were recorded in a special checklist. Organ quality was analyzed for kidney, liver, and heart. After 1 month, follow-up was done for all organ recipients from these donors.

Before commencing the study, an informed consent form was given to all participants. Ethical approval to report this case was obtained from Tehran University of Medical Sciences (IR.TUMS.IKHC.REC.1400.464).

2.3. Statistical methods

SPSS18 software (IBM Corporation, Armonk, New York, United States) was used for data analyses. Descriptive statistics, including frequency, percentage, and mean and standard deviation, were used to present the data. In addition, as analytical statistics, the chi-squared test

was used to compare demographic variables. The relationship between laboratory test results was assessed by Pearson's correlation, and a one way analysis of variance (ANOVA) was used to assess the relation between laboratory and cause of brain death. The significance level was set as $P < 0.05$.

3. Results

3.1. Patient demographics

From December 2021 to January 2023, the age of the deceased ranged between 1 year and 68 years, with a mean ± SD of 39.54 ± 17.28 years (Median: 41). More than half of the donors (158, n = 69.9%) were males. Regarding the education level of the donors, 15.7% held a university degree (Table 1).

Variable	N	%
Age (years)		
<10	12	5.3
10–20	27	11.9
20–30	35	15.5
30–40	38	16.8
40–50	35	15.5
50–60	52	23.0
>60	27	11.9
Cause of brain death		
Trauma	90	39.8
CVA	79	35.0
Hypoxia	12	5.3
Toxicity	22	9.7
P-CPR	7	3.1
Others	16	7.1
Donors' level of education		
Illiterate	54	25.7
Under diploma	56	26.7
Diploma	67	31.9
University education	33	15.7
Blood group		
A	68	30.1
B	47	20.8
O	92	40.7
AB	19	8.4
Smoking		
Yes	39	17.6
Alcohol		
Yes	18	8.1

Note: P-CPR, post cardiopulmonary resuscitation.

Table 1. Demographic data of donors.

According to the Chi-squared test, there was no significant difference between the quality of organs regarding blood group and cause of brain death ($P > 0.05$).

This test showed that there was a significant difference between the quality of organs regarding age, body mass index (BMI), and gender (Table 2).

According to the Chi-squared test, there was a significant difference between the level of urea at admission time and procurement time ($P < 0.001$), and creatinine levels at admission time and procurement time ($P < 0.001$).

In addition, a Pearson test indicated that there was a significant relationship between blood urea nitrogen (BUN) at admission time and procurement time (r: 0.77, $P < 0.001$), as well as between ALT at admission time and ALT in procurement time (r: 0.65, $P < 0.001$).

This test showed that there was a significant relationship between AST at admission time and quality of liver after transplant (r: 0.56, $P < 0.001$), and Creatinine (Cr) at admission time and Cr in procurement time (r: 0.90, $P < 0.001$) (Table 3).

Variables and transplanted organ	*F* test	*P*-value
Gender		
Kidney	48.42	0.002
Liver	301.4	<0.001
Heart	3.63	0.16*
Blood group		
Kidney	9.44	0.39
Liver	88.117	0.72
Heart	86.60	0.46
Cause of brain death		
Kidney	10.54	0.78
Liver	15.21	0.43
Heart	6.44	0.77
Age (years)		
Kidney	78.75	<0.001
Liver	38.48	0.003
Heart	67.18	<0.001
BMI		
Kidney	322.08	0.039
Liver	371.98	<0.001
Heart	225.81	0.025

Note: P < 0.05; BMI, body mass index; *Heart transplant from marginal donors is a new topic in Iran. Screening for heart donation is very strict, and heart donors are mostly under 40 years old; for this reason, the statistical results of heart donor analysis in this study are not significant.

Table 2. Comparison of demographic data and quality of organ in transplanted patients..

	BUN_1	BUN_2	Cr_1	Cr_2	AST_1	AST_2	ALT_1	ALT_2
BUN_1	1	$r = 0.77$ $P < 0.001$	$r = 0.008$ $P = 0.910$	$r = 0.63$ $P < 0.001$	$r = 0.23$ $P < 0.001$	$r = 0.25$ $P < 0.001$	$r = 0.24$ $P < 0.001$	$r = 0.12$ $P < 0.06$
BUN_2		1	$r = 0.66$ $P < 0.001$	$r = 0.67$ $P < 0.001$	$r = 0.15$ $P = 0.02$	$r = 0.14$ $P < 0.03$	$r = 0.16$ $P = 0.02$	$r = 0.09$ $P = 0.17$
Cr_1			1	$r = 0.90$ $P < 0.001$	$r = 0.02$ $P = 0.68$	$r = 0.296^{**}$ $P < 0.001$	$r = 0.00$ $P = 0.91$	$r = 0.06$ $P = 0.34$
Cr_2				1	$r = 0.29$ $P < 0.001$	$r = 0.16$ $P = 0.014$	$r = 0.24$ $P < 0.001$	$r = 0.03$ $P = 0.62$
AST_1					1	$r = 0.68$ $P < 0.001$	$r = 0.58$ $P < 0.001$	$r = 0.56$ $P < 0.001$
AST_2						1	$r = 0.61$ $P < 0.001$	$r = 0.52$ $P < 0.001$
ALT_1							1	$r = 0.65$ $P < 0.001$
ALT_2								1

Note: $P < 0.05$; ALT_1, ALT in admission time; ALT_2, ALT in procurement time; AST_1, AST in admission time; AST_2, AST in procurement time; BUN_1, BUN in admission time; BUN_2, BUN in procurement time; Cr_1, Cr in admission time; Cr2, Cr in procurement time.

Table 3. Correlation between laboratory test in organ donors.

	Df	Mean square	*F*	*P*-value
BUN_1	5	2290.538	1.476	0.19
BUN_2	5	2843.067	1.302	0.26
Cr_1	5	42.950	0.388	0.85
Cr_2	5	7.980	1.702	0.13
AST_1	5	21,894.629	0.714	0.61
AST_2	5	13,365.472	0.485	0.78
ALT_1	5	29,192.330	1.515	0.18
ALT_2	5	6128.002	0.332	0.89

Note: $P < 0.05$; ALT_1, ALT in admission time; ALT_2, ALT in procurement time; AST_1, AST in admission time; AST_2, AST in procurement time; BUN_1, BUN in admission time; BUN_2, BUN in procurement time; Cr_1, Cr in admission time; Cr2, Cr in procurement time.

Table 4. The relationship between causes of brain death and laboratory test outcomes.

Based on the one-way ANOVA test, there was no significant difference between laboratory test and cause of brain death ($P > 0.05$) (Table 4).

4. Discussion

Significant progress in all types of transplantation in recent years has dramatically increased both graft and patient survival.[22] However, the worldwide shortage of organs is a significant limiting factor for further development of organ donation and transplantation programs.[23]

According to the results of the present study, almost 70% of the brain-dead participants in this study were men, with the main cause of brain death being trauma (39.8%). The economic status of more than 89.4% of the participants was low, with many having not attained a diploma. According to the results, head trauma is the most common cause of brain death in Iran, and young drivers are at higher risk of head trauma through motor vehicle accidents.[24]

In a study undertaken by AfzalAghaee and Rahmanifar,[25] accidents constitute 71% of the causes of brain death in Iran. One of the reasons for the high prevalence of trauma in the brain-dead donors in this study can be attributed to the high number of motor vehicle accidents in Iran. Therefore, the leading cause of brain death in other countries is not the same as that in Iran. The differences in the cause of brain death from country to country highlight the importance of variable approaches to organ donation to achieve optimal results.[26] In cases of brain death caused by an accident, the time interval between the accident and the need to approach the family for organ donation may be very short. This limited time combined with the unexpected loss makes it very difficult for families to make what could be a painful decision.

The results of Souter et al.[27] showed that improved donor management may increase the number of available organs. The results of this study show that there is a significant difference in the level of ALT, AST, and urea during the time of procurement compared to the time of admission, which indicates good management of donors during admission to the procurement unit.

According to Firl et al.,[28] donor age is a well-known risk factor for poor survival after liver transplantation. These results are similar to the results of Schold et al.,[29] who showed that age has an effect on organ quality. Various studies have shown that aging is directly related to organ quality, and age has a great impact on the quality of the donated organ.[30–32] The findings of this current study align

with these previous results; there was a significant difference between the age and quality of the organ. In the older liver and kidney recipients from older donors, a significantly worse graft survival has been reported. Basar et al.[33] showed that kidneys from older donors should be used with great selectivity, discarding those organs with more than mild arterionephrosclerosis or interstitial fibrosis, or more than 20% glomerulosclerosis.[33]

In addition to age, several clinical studies have proven that the gender of the donor has a direct effect on organ survival, especially the liver and kidney. Several clinical studies have proven that the gender of the donor has a direct effect on organ survival, especially the liver and kidney.[34,35] Male donor organs are of higher quality than female ones, and male organ survival is greater than female, especially in heart transplantation.[36] Of note is the fact that, in the recipients of kidneys and livers from female donors, no significantly worse graft survival was noted.

Regarding the heart transplant in this study, the most important factor for not having a heart transplant was an ejection fraction (EF) <50. In a study by Khan et al.,[37] left ventricular (LV) EF <50% before organ donation was the strongest predictor of being disqualified for a heart transplant.

5. Conclusions

The transplant outcomes using kidneys from older liver and kidney donors were comparable to those using younger or male donors. These findings provide further evidence that decision-making about organ quality should be influenced by age and gender and emphasize the importance of transparency in organ acceptance practices.

It is worth mentioning that the experience of the coordinator in donor management has an important effect on the quality of organs donated. Considering the improvement in the results of laboratory tests of Urea, AST, and ALT levels at the time of procurement compared to admission time in the ICU, it seems that recruitment and training of healthcare professionals can help in improving the quality of the organ.

The limitations of the study include the incomplete results of laboratory tests in patient records during the posttransplant period, which led to a significant reduction in the sample size. However, considering this limitation and taking into account the hospitals across the country, we made efforts to address this issue and, for the first time in the country, monitored the posttransplant outcomes in our transplant patients.

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Author contributions

ML Conceptualization and Writing original draft. HR Review and Editing the draft. EP Analyze the data. MKh and AA Data collecting. SD Project administration and Writing final draft. All authors have read and agreed to the published version of the manuscript.

Ethical approval

Ethical approval to report this case was obtained from Tehran University of Medical Sciences (IR.TUMS.IKHC.REC.1400.464). All participants consented to become part of the study.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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