Publisher
MEDRESEARCH
www.medresearch.in

International Journal of Medical Research and Review

2019 Volume 7 Number 3 May-June

E-ISSN:2320-8686
P-ISSN:2321-127X

Research Article

Injury

Analysis of risk factors of acute kidney injury in organ donors

Zheng D.[1], Zhan Y.[2], Yang Y.[3], Tai Q.[4], Xu G.[5*]

DOI: https://doi.org/10.17511/ijmrr.2019.i03.14

[1] Donghua Zheng, Sun Yat-sen University, Guangzhou, Guangdong, China.

[2] Yaping Zhan, Sun Yat-sen University, Guangzhou, Guangdong, China.

[3] Yanxia Yang, Sun Yat-sen University, Guangzhou, Guangdong, China.

[4] Qiang Tai, Department of Critical Care Medicine, Sun Yat-sen University, Guangzhou, Guangdong, China.

[5*] Guixing Xu, Department of Neurosurgery, Sun Yat-sen University, Guangzhou, Guangdong, China.

Background: To investigate the occurrence and risk factors of acute kidney injury (AKI) in organ donors. **Methods:** Clinical data of 153 donor patients who donated organs in our hospital from January 2016 to July 2018 were collected. Patients were divided into AKI group and non-AKI group according to AKI diagnostic criteria. Clinical indicators of patients in the two groups were compared, and the related risk factors were analyzed by unifactorial and multivariate logistic regression. **Results:** The incidence of donor patients complicated with AKI was 48.37%. Unifactorial analysis suggested that the SOFA score, positive rate of blood culture, hypothermia incidence and vasoactive drug dose in donor AKI group were larger than those in non-AKI group. Multivariate Logistic regression analysis showed that the dose of booster drugs (P=0.02, OR=3.53) and the positive rate of blood culture (P=0.01, OR=6.64) were independent risk factors for donor patients complicated with AKI. **Conclusion:** The incidence of acute kidney injury in organ donors is high, with the dose of booster drugs and the positive rate of blood culture as independent risk factors for evaluation basis to assess the incidence rate of donor patients complicated with AKI.

Keywords: Organ donation, Donor, Acute Kidney Injury, Risk factors, Transplant

Corresponding Author

Guixing Xu, Department of Neurosurgery, Sun Yat-sen University, Guangzhou, Guangdong, China.
Email: xuguixing001@163.com

How to Cite this Article

Zheng D, Zhan Y, Yang Y, Tai Q, Xu G. Analysis of risk factors of acute kidney injury in organ donors. Int J Med Res Rev. 2019;7(3):231-236.
Available From
https://ijmrr.medresearch.in/index.php/ijmrr/article/view/1064

To Browse

Manuscript Received	Review Round 1	Review Round 2	Review Round 3	Accepted
2019-05-19	2019-05-25	2019-05-30		2019-06-04

Conflict of Interest	Funding	Ethical Approval	Plagiarism X-checker	Note
No	Nil	Yes	9%	

Introduction

Acute kidney injury (AKI) is a syndrome characterized by the rapid reduction of glomerular filtration rate (GFR) and accumulation of nitrogen products (blood urea nitrogen (BUN) and serum creatinine (SCr)).

It's also a kind of serious complication of patients with severe brain injury [1], which can also cause other organ dysfunction. At present, brain injury donors are the main sources of organ transplantation. Without donors, there would be no organ transplantation, aggravating the shortage of organs worldwide [2]. AKI and renal failure would delay the recovery of renal function after kidney transplantation.

In the worst case, the kidney source can be discarded, thus a huge waste. In clinical practice, the incidence of acute kidney injury among organ donors is very high. Early detection and early intervention of AKI will help improve the success rate of kidney donation and reduce the incidence of delayed recovery of renal function after transplantation [3]. Currently, there have been reports on AKI in patients with cerebral hemorrhage at home and abroad [4], but there are still few studies on the risk factors of AKI and other related factors in organ donors. In this paper, the incidence and risk factors of AKI in 153 organ donors admitted to the center were analyzed to provide clinical basis for prevention and intervention of AKI in donors [5].

Data and Methods

Research Objects: 153 organ donors were selected from the Department of Critical Care Medicine of the First Affiliated Hospital of Sun Yat-sen University between January 2016 and July 2018. All patients had severe brain injury. According to the China's Technical Guidelines for the Determination of Brain Death (2014 edition), 85% of the patients met the criteria for brain death [6].

The causes of brain injury include: severe craniocerebral trauma, hypertensive cerebral hemorrhage, aneurysm rupture hemorrhage, ischemic hypoxic encephalopathy, large cerebral infarction and intracranial tumor.

Inclusion criteria: No gender restriction; patients with brain injury who meet the ethical requirements of organ donation.

Diagnostic criteria for AKI [7]: renal function decrease within 48 hours; absolute creatinine increase ≥26.4uomol/L or ≥50% (1.5 times the baseline value), or urine ≤0.5ml/kg/h over six consecutive hours; patients were classified in accordance with the standard stages of AKIN related AKI [1]. Diagnostic criteria for septic shock [8]: 1) meeting the diagnostic criteria for sepsis; 2) constant need of vasopressor treatment to maintain the average arterial pressure greater than or equal to 65mmHg and the serum lactic acid level greater than 2mmol/L after adequate volumetric resuscitation.

Exclusion criteria: Less than 1 year old; previous history of chronic renal insufficiency or severe cirrhosis; ICU length for less than 12 hours; pregnant; patients participating in other intervening clinical trials.

Methods: All subjects were treated with drugs to improve circulation, fight infection, maintain internal environment stability, and ventilator-assisted breathing. Record donor patients of their clinical data: gender, age, height and weight index (BMI), hypertension, diabetes history, APACHEII scores, SOFA score (see Table 1), norepinephrine NE dose, arterial blood oxygen partial pressure, hemoglobin Hb, lactic acid LAC, serum sodium level of Na+, potassium concentration K+, presence of low body temperature, positive rate of blood culture, ICU length.

Table-1: SOFA Score Criteria

Item	Score				
	1 Score	2 Score	3 Score	4 Score	5 Score
Breathing PaO2/FiO2	≥400	<400	<300	<200	<100
Coagulation PLT (×109 L-1)	≥150	<150	<100	<50	<20
Liver					
TBIL (μmol/L)	< 20	20~32	33~101	102~204	> 201
CV	MAP≥70 mm Hg	MAP < 70 mm Hg	DA < 0.5 or DBa	DA5-15 or NE≤0.1a	DA > 15 or NE > 0.1a
CNSGlasgow Scoreb	15	13~14	10~12	6~9	< 6
Kidney					
SCr (μmol/L)	<110	110~170	171~299	300~440	>440
UV (mL/d)	-	-	-	<500	<200

Note: PaO_2 is partial pressure of arterial blood oxygen; FiO_2 is the concentration fraction of oxygen in the inhaled air. PaO2/FiO2 is the oxygenation index; a refers to catecholamines in the unit of mug (/kg·min), maintained for at least 1 hour.

B indicates Glasgow scores ranging from 3 to 15. The higher the score, the better the neurological function. "- " means none. According to the diagnostic criteria of AKIN, patients were divided into non-AKI group and AKI group. AKI group can be divided into stage 1, stage 2 and stage 3.

Statistical Methods- SPSS 16.0 was used for analysis. Normal distribution was measured by mean ± standard deviation (chi-square), and two independent sample T-Test was used for comparison between groups. Measurement data of non-normal distribution were represented by median (M) and interquarile spacing (IQR), and comparison between groups was conducted by Mann-Whitney U-Test. Enumeration data were expressed by case number and percentage (%).

Comparison among groups was conducted by chi-square test or Fisher's exact probability method. Univariate and multivariate Logistic regression were used to analyze the related risk factors of postoperative AKI, and the results were expressed by odds ratio (OR) and confidential interval (CI). α =0.05 was defined as the test level. P< 0.05 was considered statistically significant.

Results

There were 153 donor patients in total, including 79 patients without AKI and 74 patients with AKI. The incidence of donor patients complicated with AKI was 48.37%. There were 24 patients in AKI stage 1 (15.69%), 11 patients in AKI stage 2 (7.19%), and 39 patients in AKI stage 3 (25.49%) [2], as shown in Table 2.

Table-2: Incidence rate of donors in AKI groups

Item	Non-AKI	AKI Stage 1	AKI Stage 2	AKI Stage 3
Case Number	79	24	11	39
Percentage	51.63	15.69	7.19	25.49

Table-3: Clinical data of donors from non-AIK group and AKI group

Indicators	Non-AKI group	AKI group
	(N=79)	(N= 74)
Male/female (number)	56/23	50/24
Age	42.2±11.3	43.9±15.9
BMI	21.9±4.0	24.5±5.3
Diseases in total [例(%)]		
High blood pressure	8(5.2)	10(6.5)
Diabetes	3(1.9)	5(3.3)
APACHEII scores	27.8+4.5	29.9+3.9
SOFA scores	10.8±3.5	15±4.3
History of craniocerebral operation [Case number (%)]		
Yes	21 (13.7)	18 (11.8)
No	58 (37.9)	56 (36.6)
Cause of brain injury [Case number (%)]		
Craniocerebral trauma	29 (18.9)	39 (25.5)
Hypertensive cerebral hemorrhage	30 (19.6)	21 (13.7)
Aneurysm rupture	6 (3.9)	7 (4.8)
Hypoxic ischemic encephalopathy	8(5.2)	6 (3.9)

Table-4:Univariate Logistic Regression Analysis of Donors

Item	OR Value	95%CI	P Value
Male	1.25	0.56~2.65	0.63
Age	1.07	0.93~1.76	0.45
APACHEII Scores	1.60	0.71~3.90	0.12
SOFA Scores	2.69	1.21~4.96	0.04
ICU Length	0.96	0.85~1.66	0.15
Low Body Temperature	2.26	2.18~3.98	0.04
NE Dose	3.53	3.13~6.98	0.02
Arterial oxygen pressure	1.07	0.90~1.99	0.36
Hemoglobin Hb	1.19	0.87~1.60	0.48
Lactic acid LAC	1.30	1.12~1.45	0.11
Na+ level	0.94	0.88~1.02	0.73
K+ concentration	1.03	0.91~1.37	0.26
Positive rate of blood culture	6.64	4.87~9.01	0.01
Platelet PLT	0.97	0.98~1.02	0.15

153 donor patients were recorded for their gender, age, APACHEII scores, SOFA score (see Table 1), ICU length, presence of low body temperature, norepinephrine NE dose, arterial blood oxygen partial pressure, hemoglobin Hb, lactic acid LAC, serum sodium level of Na +, potassium concentration of K +, positive rate of blood culture, PLT in blood platelet, single factor logistic regression analysis, as shown in table 3.

Single-factor Logisti regression analysis suggested that, compared with the non-AKI group, patients in the AKI group have a SOFA score of P=0.04, with hypothermia P=0.04, the dose of vasoactive drugs P=0.02, and the positive rate of blood culture P=0.01, all P values less than 0.05 with statistical significance. See Table 4.

Multivariate Logistic Regression Analysis: Variables such as SOFA score, booster dose, hypothermia and positive rate of blood culture were selected into multivariate Logistic regression model, and the results showed that: booster dose (P=0.02, OR=3.53) and positive rate of blood culture (P=0.01, OR=6.64) were independent risk factors for donor patients with concurrent AKI.

Discussion

Acute kidney injury (AKI) refers to a common clinical syndrome in which the renal function decline in a constant or unexpected way. AKI is a common clinical disease and one of the most common complications for patients in critical. In recent years, epidemiological data on AKI have been reported repeatedly.

Research data from LEWINGTON [9] et al. show that there are about 13.3 million hospitalized patients with AKI every year, and nearly 1.7 million of them die from AKI and its complications. According to the latest research, the current global prevalence rate of AKI is as high as 3.2-9.6% [10]. At the same time, AKI is one of common complications in organ donations. This research shows that: the incidence of donor patients complicated with AKI was 48.37%, far higher than the global average rate, namely nearly half of the donors have different stages of AKI.

Therefore, researches in this field, including studies of risk factors and the recognition of them hold clinical significances, providing guidance to avoid AKI as much as possible [11,12]. AKI is often associated with multiple organ dysfunction syndrome (MODS). In addition to renal failure in patients with MODS, non-renal failure factors can also affect the occurrence and development of AKI. Studies have shown that about 2/3 of AKI occurs in MODS, insufficient circulatory capacity and septic shock.

In addition, AKI patients have a higher disease severity score and multiple organ damages, with the number of organ failure significantly increasing along with the aggravation of AKI grading. The severity of the disease can be predicted by SOFA scores. The higher the score is, the more serious the illness is, which can better reflect the severity of the patient’s situation. The more severe the disease, the higher the incidence of AKI [13].

Therefore, in this study, SOFA score is correlated with the incidence of AKI in the donor, which is clinically consistent. The booster dose often indicates the extent of shock in patients. For donor patients with severe shock, the dosage of vasoactive drugs is significantly increased. Infectious shock is very common among organ donors, as the donor is bedridden with no cough reflex and brain stem failure. Thus, the vasopressor dose indirectly reflects the extent of septic shock.

In patients with infection or sepsis, the body releases a large number of endogenous inflammatory mediators under the action of endotoxin, and the expression of various cytokines is up-regulated to varying degrees. Clinical studies have shown that serum interleukin-10 (IL-10), macrophage migration inhibitory factor and IL-6 increased much more significantly in AKI patients with infectious shock severe than those with non-AKI or mild AKI [14].

The hemodynamic of patients with septic shock presents the state of "high cardiac output and low peripheral resistance", under which the body maintains a high cardiac output without much change in renal vasoconstriction, renal oxygen consumption, kidney histology while the renal vein system marks hyperemia, leading to reduced renal perfusion pressure, glomerular filtration gradient descent, and the occurrence of AKI [15].

At this point, if given a large amount of fluid, body would be overload, leading to further increase in venous pressure, thereby aggravating kidney damage. Therefore, in clinical practices, hemodynamic changes should be closely monitored during the early fluid resuscitation of patients with septic shock, and the dosage of noradrenalin should be reduced as much as possible so as to avoid the occurrence or aggravation of AKI [16].

The presence of positive blood culture indicates that the donor patient is highly likely to have sepsis. Due to the release of a large number of inflammatory mediators caused by the blood infection of pathogens, the necrosis of renal tubules is accelerated in the patient on the one hand, and on the other hand, the perfusion level of the kidney is significantly reduced [17]. This study suggested that the positive rate of blood culture (P=0.022, OR=6.649) was an independent risk factor for AKI patients. Therefore, timely and active anti-infection treatment should be conducted for the detection of positive blood culture of donors, which is beneficial to control AKI and can improve the success rate of kidney donation [18]. As organ donors progress to brain death, the thermoregulation center would be damaged, leading to extremes of hyperthermia or hypothermia. However, hypothermia patients are more prone to acute kidney injury [19].

Hypothermia patients have a relatively high probability of AKI due to their poor response to vasoactive drugs and severe insufficiency in organ perfusion as well as renal perfusion.

Conclusion

In conclusion, clinical attention should be paid to the incidence of AKI in donor patients, and early intervention should be carried out accordingly. The dose of booster drugs and the positive rate of blood culture are independent risk factors for donor patients complicated with AKI. Donor's kidney function should be monitored closely.

Alternatively, the use of vasopressors should be reduced by improving the hemodynamics of the donor, and pathogens sensitive antibiotics could be used as soon as possible to reduce the positive rate of blood culture. For patients with hypothermia, it is practical to rewarm the patients along with monitoring their SOFA score in order to improve their kidney function and increase the success rate of kidney donations [20].

Contribution by authors

01. **Donghua Zheng, YapingZhan,–** data collection and preparing the manuscript
02. **Yanxia Yang, Qiang Tai–** methodology preparation and helping in manuscript writing
03. **Dr Guixing Xu–** statistical analysis and deriving statistical inference.

Acknowledgements

The researchers would like to thank the physicians in the Department of Neurosurgery and Critical Medicine for their help in the process of collecting and saving the data.

Reference

01. Warnock DG. Towards a definition and classification of acute kidney injury. J Am Soc Nephrol. 2005 Nov;16(11)3149-50.
doi: 10.1681/ASN.2005090934 [Crossref]

02. Robert A, Metzgera, Francis L et al. Expanded criteria donors for kidney transplantation. American Journal of Transplantation. 2003;3(Suppl 4)114–125.
[Crossref]

03. Zheng YT, Chen CB, Yuan XP, et al. Impact of acute kidney injury in donors on renal graft survival- a systematic review and Meta-Analysis. Ren Fail. 2018 Nov;40(1)649-656.
doi: 10.1080/0886022X.2018.1535982 [Crossref]

04. Ansaritoroghi M, Nagaraju SP, Nair RP, et al. Study on Acute Kidney Injury in Patients with Spontaneous Intracerebral Hemorrhage- an Overview from a Tertiary Care Hospital in South India. World Neurosurg. 2019 Mar;123;e740-e746.
doi: 10.1016/j.wneu.2018.12.018 [Crossref]

05. Hall IE, Schröppel B, Doshi MD, et al. Associations of deceased donor kidney injury with kidney discard and function after transplantation. Am J Transplant. 2015 Jun;15(6)1623-31.
doi: 10.1111/ajt.13144 [Crossref]

06. Su Y, Yang Q, Liu G, et al. Diagnosis of brain death- confirmatory tests after clinical test. Chin Med J (Engl). 2014;127(7)1272-7.
[Crossref]

07. John A Kellum, Norbert Lameire, Peter Aspelin, et al. Kidney disease- Improving global outcomes (KDIGO) acute kidney injury work group, KDIGO clinical practice guideline for acute kidney injury. Kidney Int Suppl. 2012;2(1)1-138.
[Crossref]

08. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016 Feb 23;315(8)801-10.
doi: 10.1001/jama.2016.0287 [Crossref]

09. Lewington AJ, Cerdá J, Mehta RL. Raising awareness of acute kidney injury- a global perspective of a silent killer. Kidney Int. 2013 Sep;84(3)457-67.
doi: 10.1038/ki.2013.153 [Crossref]

10. Kam Tao Li P, Burdmann EA, Mehta RL, et al. Acute kidney injury- Global health alert. J Nephropathol. 2013 Apr;2(2)90-7.
doi: 10.12860/JNP.2013.15 [Crossref]

11. Anil Kumar MS, Khan SM, Jaglan S, et al. Successful transplantation of kidneys from deceased donors with acute renal failure- three-year results. Transplantation. 2006;82;1640–1645.
[Crossref]

12. Ali T, Dimassi W, Elgamal H, et al. Outcomes of kidneys utilized from deceased donors with severe acute kidney injury. QJM. 2015 Oct;108(10)803-11.
doi: 10.1093/qjmed/hcv033 [Crossref]

13. Lin J, Gallagher M, Bellomo R, et al. SOFA coagulation score and changes in platelet counts in severe acute kidney injury- Analysis from the randomized evaluation of normal versus augmented level (RENAL) study. Nephrology (Carlton). 2019 May;24(5)518-525.
doi: 10.1111/nep.13387 [Crossref]

14. Suh SH, Kim CS, Choi JS, et al. Acute kidney injury in patients with sepsis and septic shock-risk factors and clinical outcomes. Yonsei Med J. 2013 Jul;54(4)965-72.
doi: 10.3349/ymj.2013.54.4.965 [Crossref]

15. Ahmed W, Memon JI, Rehmani R, et al. Outcome of patients with acute kidney injury in severe sepsis and septic shock treated with early goal-directed therapy in an intensive care unit. Saudi J Kidney Dis Transpl. 2014 May;25(3)544-51.
[Crossref]

16. Medeiros P, Nga HS, Menezes P et al. Acute kidney injury in septic patients admitted to emergency clinical room- risk factors and outcome. Clin Exp Nephrol. 2015 Oct;19(5)859-66.
doi: 10.1007/s10157-014-1076-9 [Crossref]

17. Zilberberg MD, Shorr AF, Micek ST, et al. Risk factors for 30-day readmission among patients with culture-positive severe sepsis and septic shock- A retrospective cohort study. J Hosp Med. 2015 Oct;10(10)678-85.
doi: 10.1002/jhm.2420 [Crossref]

18. Jacobi J, Rebhan D, Heller K, et al. Donor acute kidney injury and short-term graft outcome in renal transplantation. Clin Transplant. 2014 Oct;28(10)1131-41.
doi: 10.1111/ctr.12425 [Crossref]

19. Yoon HJ, Kim MC, Park JW, et al. Hypothermia-induced acute kidney injury in an elderly patient. Korean J Intern Med. 2014 Jan;29(1)111-5.
doi: 10.3904/kjim.2014.29.1.111 [Crossref]

20. Farney AC, Rogers J, Orlando G, et al. Evolving experience using kidneys from deceased donors with terminal acute kidney injury. J Am Coll Surg. 2013 Apr;216(4)645-55;discussion 655-6.
doi: 10.1016/j.jamcollsurg.2012.12.020 [Crossref]