ORIGINAL RESEARCH

Influence of Impaired Hydration Status on Postoperative in-Hospital Death in Patients with Acute Type A Aortic Dissection

Yaqin Chen[1,*], Yanchun Peng[2,*], Xuecui Zhang[1], Liangwan Chen[3], Yanjuan Lin [ID][2,4]

[1]School of Nursing, Fujian Medical University, Fuzhou, People's Republic of China; [2]Department of Nursing, Union Hospital of Fujian Medical University, Fuzhou, People's Republic of China; [3]Department of Cardiac Surgery, Union Hospital of Fujian Medical University, Fuzhou, People's Republic of China; [4]Department of Cardiac Surgery Nursing, Union Hospital of Fujian Medical University, Fuzhou, People's Republic of China

*These authors contributed equally to this work

Correspondence: Yanjuan Lin, Department of Nursing, Union Hospital, Fujian Medical University, No. 29 Xinquan Road, Fuzhou, Fujian Province, 350001, People's Republic of China, Tel +86 059186218336, Fax +8683344034, Email fjxhyjl@163.com; Liangwan Chen, Department of Cardiac Surgery, Union Hospital, Fujian Medical University, No. 29 Xinquan Road, Fuzhou, Fujian Province, 350001, People's Republic of China, Tel +86 059186218581, Fax +86059183301393, Email fjxhlwc@163.com

Background: The hydration state of the body is getting more and more attention from researchers. The purpose of this study is to investigate the relationship between impaired hydration status and postoperative hospitalization death in patients with A AAD.

Methods: From January 2019 to October 2021, the clinical data of 299 patients undergoing A AAD surgery were retrospectively analyzed. Patients were divided into normal hydration group, imminent dehydration group and current dehydration group according to the dehydration standard at admission. Univariate and multivariate logistic regression analysis were used to determine the independent risk factors for in-hospital death of patients with A AAD.

Results: Postoperative in-hospital death in A AAD patients was significantly more common in the imminent and current dehydration groups (>295mmol/L) (26.7% vs 11.9%; P=0.001). The length of ICU stay was significantly longer in the impending and current dehydration groups (P<0.05). After controlling for other factors by multivariate logistic regression analysis, the results showed that the group of impending and current dehydration (>295) (OR=3.61, 95% confidence interval [CI]: 1.61–8.06; P=0.002), CRRT (OR=10.55, 95%[CI]: 3.59–31.01; P<0.001), lactic acid (OR=1.25, 95%[CI]: 1.13–1.38; P<0.001), CAD (OR=5.27, 95%[CI]: 1.12–24.80; P=0.035) was an independent risk factor for in-hospital death in A AAD patients. Albumin (OR=0.92, 95%[CI]: 0.85–0.99; P=0.040) is a protective factor.

Conclusion: The presence of high serum osmotic pressure on admission of A AAD patients can independently predict postoperative death, and the impaired body hydration status should be paid attention to.

Keywords: acute type A aortic dissection, dehydration, death, surgery, outcome

Introduction

Acute type A aortic dissection (A AAD) is A life-threatening vascular emergency requiring urgent diagnosis and treatment. Although treatments continue to improve, especially successful surgical treatment in time, but still in hospital mortality of 18 ~ 22%.[1–4] Studies have found that clinical outcomes in A AAD patients with difference is very big,[5] even after treatment in acute index event still in high-risk state, worthy of attention. A AAD patients, once identified, are generally transported by the emergency department for emergency surgery. Buaprasert et al according to a study in patients with emergency admission 1/5 of the existence of high permeability dehydration.[6] Previous experiments have shown that in the state of hypertonic dehydration, the blood volume is relatively reduced, the blood is concentrated, and the blood viscosity is increased, which can not meet the blood supply of the corresponding organs. This is one of the important reasons leading to preoperative hypoperfusion of blood volume in patients with A AAD. As is known to all,

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poor perfusion is an evidence-based risk factor for increased mortality.[7,8] Girdauskas et al found that the presence of preoperative hypoperfusion in patients with A AAD was associated with an increased risk of postoperative death, and hypoperfusion was the most decisive preoperative factor.[9] However, it is not known whether impaired hydration, such as hypertonic dehydration, is present in patients with A AAD before surgery.

In recent years, many scholars begin to pay close attention to the body gradually the change of the state of hydration, and dehydration is a manifestation of impaired hydration status. Hypertonic dehydration occurs when the kidneys lose too much water due to inadequate fluid intake, resulting in elevated serum osmolarity.[10] Studies have shown that dehydration may lead to an increased risk of death from cardiovascular disease.[11] The predictive value of serum osmolality for mortality has been reported in some specific patients, such as those with intracranial hemorrhage and acute coronary syndromes.[12,13] In an intensive care unit (ICU) in the study, in the heart, brain, blood vessels, and gastrointestinal tract disease in critically ill patients in the hospital, high serum osmotic pressure is associated with increased mortality.[14] However, the association between serum osmolality imbalance and mortality has not been studied. Effective identification of high-risk groups and implementation of interventions to reverse dehydration and reduce the current risk of dehydration[15] will help improve the clinical prognosis of patients with A AAD.

Clinically, effective assessment of hydration status is hampered by the complexity of patient signs and the low accuracy of instrumental techniques used for assessment.[16] The bioelectrical impedance analyzer (BIA) currently used in clinical practice is susceptible to external factors, such as sweat, skin temperature, and electrode position, which can significantly affect the measurement results.[15] Studies have shown that the difference between directly measured and calculated osmolality is negligible[15,17] and that serum osmolality may be a better feature of actual dehydration even in young adults.[18] Therefore, this research by calculating A AAD patients serum osmotic pressure on admission to hospital to evaluate hydration damaged condition.

Based on the above analysis, this study retrospectively analyzed 299 eligible patients with A AAD, in order to explore the relationship between serum osmolality on admission and postoperative in-hospital death in patients with A AAD, so as to provide a better theoretical basis for clinical practice.

Method
Patient Collection
A total of 400 patients diagnosed with A AAD by CT angiography and magnetic resonance imaging (MRI) were admitted to the Department of Cardiac Surgery of the Union Hospital Affiliated to Fujian Medical University from January 2019 to October 2021. All patients with A AAD were screened postoperatively in the intensive care unit (ICU) and received standard care. Qualified participants will be included in the final analysis if they meet the following criteria. The inclusion criteria are: (1) onset time<14 days; (2) aged 18 or above. Patients with the following conditions were excluded: (1) preoperative hypernatremia; (2) severe infection, autoimmune disease, multiple organ failure (MODS), sepsis or cancer at admission; (3) patients with incomplete clinical data. This study was approved by the Ethics Committee of the hospital, and the Ethics Committee approval number was 2021KJT055. This study is a retrospective observational study of informed consent, and conform to the declaration of Helsinki. We ensured that all patient data were confidential and anonymized and were used only for data analysis.

Data Collection
The clinical data of patients were collected retrospectively by searching clinical electronic databases. The patients' socio-demographic characteristics, including age, sex, BMI, and past history, were collected. Collect diagnosis and treatment records and laboratory test results, such as temperature, heart rate, blood pressure, intraoperative clinical data, blood tests and biochemical tests on admission.

Variable Definition
Preoperative hydration state (normal hydration or dehydration) results were grouped according to the calculation formula of serum osmotic pressure: $1.86 \times (Na^+ + K^+) + 1.15 \times glucose + urea + 14$ (mmol/L).[19] In-hospital death was the primary end

point, and secondary end points were other postoperative complications during hospitalization, including liver insufficiency, renal insufficiency, gastrointestinal bleeding, MODS, cerebral infarction, and neurological complications. MODS was defined as sequential organ failure score > 6 at least 48 hours after admission (2 consecutive days or more).[20]

Data Analysis

Statistical analysis was performed by IBM SPSS® 26.0, and GraphPad Prism 9.0 for Windows (GraphPad software, La Jolla, CA, USA) was used for plotting. The hydration status (serum osmotic pressure) of all patients at admission was divided into normal hydration group (275–295) and imminent and current dehydration group (>295). The characteristics of patients between the two groups were analyzed and compared. The measurement data were expressed by Mean and SD. When it satisfies the normal distribution, it's described by means and standard deviations; When normal distribution is not satisfied, median and interquartile spacing are used. For the comparison of non-normal distribution data, the Mann–Whitney rank sum (U) test was used. Counting data were represented by numbers and percentage values (%), and Chi-square test was used to compare differences of categorical variables. When the conditions of Chi-square test were not met, Fisher's exact test was used, and the value $P<0.05$ (bilateral) was considered significant. First, single logistic regression analysis was used to preliminarily determine the potential risk factors of in-hospital death ($P<0.1$), and then multiple logistic regression analysis was used to confirm the risk factors ($P<0.05$).

Results

A total of 400 patients with A AAD were enrolled between January 2019 and October 2021. Excluding 21 patients with incomplete medical records, 10 patients with hypernatremia on admission and 70 patients without surgery, 299 patients were included in the study. Of these, 55 died and 244 survived (Figure 1). As shown in Table 1, there were 221 males (73.9%) and 78 females (26.1%). The median age of patients was 54.0. There were 198 patients (66.2%) with hypertension, 136 patients (45.5%) with smoking, and 93 patients (31.1%) with drinking alcohol. In this study, the mortality rate of patients with A AAD was 18.4%.
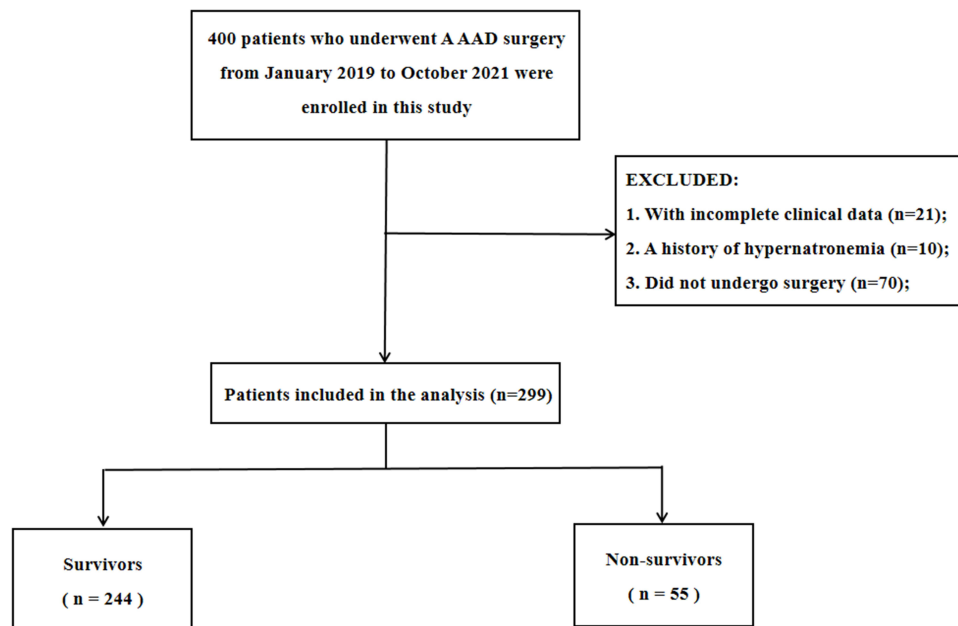
Figure 1 Patient flow chart of the cohort.
Abbreviation: A AAD, Acute type A aortic dissection.

Table 1 Baseline Clinical Data of Patients with A AAD at Admission

Variables	Total (n=299)	Hydration Status (Serum Osmolality)		P
		Euhydration: 275–295 (n=168)	Impending and Current Dehydration: >295 (n=131)	
Demographic characteristics				
Age (y), median (IQR)	54.0 (44.0, 62.0)	52.0 (42.0, 62.0)	55.0 (47.0, 62.0)	0.105
Male, n (%)	221 (73.9)	125 (74.4)	96 (73.3)	0.826
BMI (kg/m2), median (IQR)	24.9 (24.2, 27.3)	24.8 (24.3, 27.2)	24.9 (24.1, 27.4)	0.470
Past medical history, n (%)				
Hypertension, n (%)	198 (66.2)	115 (68.5)	83 (63.4)	0.356
Diabetes mellitus, n (%)	12 (4.0)	4 (2.4)	8 (6.1)	0.103
Smoker, n (%)	136 (45.5)	81 (48.2)	55 (42.0)	0.283
Drinker, n (%)	93 (31.1)	56 (33.3)	37 (28.2)	0.346
Vital signs on admission				
Postoperative LVEF (%), median (IQR)	62.9 (60.2, 66.3)	63.0 (60.2, 67.2)	62.9 (60.1, 65.8)	0.378
HR, mean (SD)	80.0 (68.0, 89.0)	80.0 (70.0, 90.0)	78.0 (65.0, 88.0)	0.204
Systolic BP (mm/Hg), median (IQR)	140.0 (120.0, 158.0)	141.0 (121.3, 163.3)	136.0 (118.0, 156.0)	0.191
Diastolic BP (mm/Hg), median (IQR)	75.0 (64.0, 85.0)	75.0 (67.0, 86.0)	75.0 (62.0, 85.0)	0.466
PP (mm/Hg), median (IQR)	62.0 (49.0, 78.0)	64.0 (49.3, 80.0)	60.0 (48.0, 78.0)	0.342
Serum osmolality (mmol/L), median (IQR)	294.3 (290.6, 298.0)	291.0 (287.9, 293.0)	299.0 (296.4, 301.7)	<0.001*

Note: *Significant difference at P value < 0.05.
Abbreviations: BMI, body mass index; BP, blood pressure; PP, pulse pressure; LEVF, left ventricular ejection fraction; HR, heart rate; SD, standard deviation; IQR, interquartile range.

Preoperative Clinical Data Characteristics of the Two Groups

According to the groups of water loss/dehydration, they were divided into euhydration group (275–295 mmol/L) and impending and current dehydration group (>295 mmol/L). The relevant baseline characteristics of the two groups are shown in Table 2. The difference of serum osmotic pressure between the two groups was statistically significant ($P<0.05$). WBC, neutrophil count, serum creatinine, and blood glucose were significantly higher in the impending and current dehydration groups than in the normal hydration group ($P<0.05$). PLT of the euhydration group was significantly higher than that of the impending and current dehydration groups, and the difference was statistically significant ($P<0.05$). There was no significant difference in hemoglobin, albumin and lactic acid.

Table 2 Preoperative Laboratory Test Data of the Patients Grouped by Hydration Status

Variables	Total (n=299)	Hydration Status (Serum Osmolality)		P
		Euhydration: 275–295 (n=168)	Impending and Current Dehydration: >295 (n=131)	
WBC ($\times 10^9$/L), median (IQR)	12.4 (9.6, 15.2)	11.7 (9.0, 14.5)	13.4 (10.7, 16.1)	0.001*
Neutrophil ($\times 10^9$/L), median (IQR)	11.0 (8.1, 13.9)	10.0 (7.3, 13.1)	12.3 (9.7, 14.9)	0.000*
Hb (g/L), median (IQR)	133.0 (121.0, 144.0)	132.0 (120.0, 144.0)	133.0 (121.0, 142.0)	0.635
PLT ($\times 10^9$/L), median (IQR)	180.0 (145.0, 228.0)	193.5 (152.5, 237.8)	171.0 (131.0, 209.0)	0.001*
Albumin (g/L), median (IQR)	38.8 (35.8, 41.2)	38.8 (35.6, 41.2)	38.8 (36.4, 41.3)	0.812
SCr (umol/L), median (IQR)	90.0 (66.0, 116.0)	77.0 (59.0, 104.5)	103.0 (76.0, 131.0)	0.000*
Lac (mmol/L), median (IQR)	5.3 (3.1, 6.5)	5.3 (2.6, 6.5)	5.3 (3.3, 6.5)	0.227
Blood glucose (mmol/L), median (IQR)	7.1 (5.3, 7.7)	6.6 (5.3, 7.1)	7.1 (5.7, 8.2)	0.001*

Note: *Significant difference at P value < 0.05.
Abbreviations: WBC, white blood cell; Hb, hemoglobin; PLT, platelet; SD, standard deviation; IQR, interquartile range; SCr, serum creatinine; Lac, lactic acid.

Intraoperative Clinical Data Characteristics of the Two Groups

As shown in Table 3, there was no statistically significant difference in operation duration, CPB duration, and aortic occlusion duration between the euhydration group and the impending and current dehydration group ($P>0.05$). Compared with the normal hydration group, patients in the impending and current dehydration groups received mechanical ventilation for a significantly longer time, with statistical significance ($P<0.05$).

Comparison of Postoperative Clinical Outcome Between the Two Groups

A postoperative hospital death in A AAD patients was significantly more common in the impending and current dehydration groups (>295mmol/L) (26.7% vs 11.9%; $P=0.001$) (see Table 4 and Figure 2). As shown in Table 4, patients in the dehydration group were more likely to develop acute renal insufficiency than those in the euhydration group (26.7% vs 15.5%; $P=0.017$). The duration of ICU stay of patients in the impending and current dehydration groups was significantly higher than that in the euhydration group, and the difference was statistically significant ($P<0.05$). There were no significant differences in the incidence of acute renal insufficiency, gastrointestinal bleeding and MODS between the two groups.

Multivariate Logistic Regression Analysis Results

As shown in Table 5, the independent risk factors of postoperative hospital death in A AAD patients were further analyzed by logistic regression. Univariate logistic regression analysis showed that impending and current dehydration, serum albumin, age, smoking, LVEF, lactic acid and hemoglobin were correlated with in-hospital death ($P<0.1$), which may be risk factors for postoperative in-hospital death in A AAD patients. After multivariate logistic regression analysis, the results showed that impending dehydration and dehydration group (>295) (OR=3.61, 95% confidence interval (CI): 1.61–8.06; $P=0.002$), CRRT (OR=10.55, 95%(CI): 3.59–31.01; $P<0.001$), lactic acid (OR=1.25, 95%(CI): 1.13–1.38;

Table 3 The Clinical Data of Intraoperative Patients Were Grouped by Hydration Status

Variables	Total (n=299)	Hydration Status (Serum Osmolality)		P
		Euhydration: 275–295 (n=168)	Impending and Current Dehydration: >295 (n=131)	
Operating time (min), median (IQR)	297.0 (262.0, 355.0)	295.0 (265.0, 346.5)	303.0 (260.0–365.0)	0.540
CPB time (min), median (IQR)	141.0 (118.0, 176.0)	140.0 (118.0, 176.0)	144.0 (119.0, 176.0)	0.743
Crossclamp time (min), median (IQR)	62.0 (46.0, 93.0)	61.5 (45.3, 98.0)	62.0 (46.0, 89.0)	0.790
Duration of MV (h), median (IQR)	42.0 (21.0, 91.2)	36.6 (18.5, 75.8)	58.2 (30.0, 109.5)	0.002*

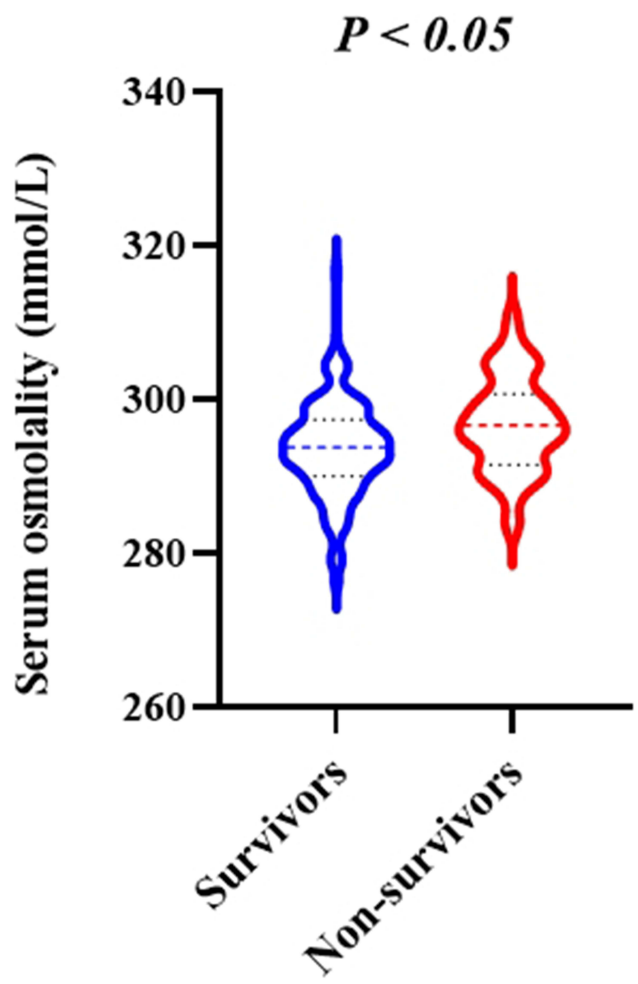**Note**: *Significant difference at *P* value < 0.05.
Abbreviations: CPB, cardiopulmonary bypass; MV, mechanical ventilation.

Table 4 In-Hosiptal Outcomes After a AAD Surgery Were Grouped by Hydration Status

Variables	Total (n=299)	Hydration Status (Serum Osmolality)		P
		Euhydration: 275–295 (n=168)	Impending and Current Dehydration: >295 (n=131)	
Acute renal insufficiency, n (%)	61 (20.4)	26 (15.5)	35 (26.7)	0.017*
Acute liver insufficiency, n (%)	48 (16.1)	27 (16.1)	21 (16.0)	0.992
All acute dissection rupture, n (%)	2 (0.7)	—	2 (1.5)	0.410
Gastrointestinal hemorrhage, n (%)	16 (5.4)	7 (4.2)	9 (6.9)	0.303
MODS, n (%)	6 (2.0)	2 (1.2)	4 (3.1)	0.191
In-hospital mortality, n (%)	55 (18.4)	20 (11.9)	35 (26.7)	0.001*
ICU stays (d), median (IQR)	4.9 (2.9, 7.8)	4.3 (2.8, 6.8)	5.5 (3.3, 8.8)	0.008*

Note: *Significant difference at *P* value < 0.05.
Abbreviations: MODS, multiple organ dysfunction syndrome; ICU, intensive care unit; IQR, interquartile range.

Figure 2 The violin plots for hydration status grouping in survivors group and non-survivors group.
Note: Significant difference at *P* value < 0.05.

P<0.001), CAD (OR=5.27, 95%(CI): 1.12–24.80; *P*=0.035) was an independent risk factor for in-hospital death in patients with A AAD, serum albumin (OR=0.92, 95%(CI): 0.85–0.99; *P*=0.040) was a protective factor for hospitalization outcomes.

Table 5 Determine the Factors Affecting in-Hospital Mortality by Univariate and Multivariate Logistic Regression Analysis

Independent Variables	Univariate Analysis			Multivariate Analysis		
	OR	95% CI	*P*	OR	95% CI	*P*
Dehydration: >295 (mmol/L)	2.698	1.471–4.948	0.001*	3.608	1.614–8.064	0.002*
Serum albumin (g/L)	0.888	0.833–0.947	<0.001*	0.920	0.850–0.996	0.040*
CRRT (n)	1.031	1.005–1.057	0.019*	10.546	3.586–31.008	<0.001*
Drinkers (n)	1.114	1.058–1.312	0.025*	0.883	0.353–2.206	0.789
Lac (mmol/L)	1.310	1.212–1.416	0.004*	1.248	1.127–1.382	<0.001*
CAD (n)	0.974	0.959–0.990	0.001*	5.272	1.121–24.802	0.035*
Preoperative LEVF (%)	0.958	0.918–1.001	0.053	0.972	0.917–1.030	0.330

Note: *Significant difference at *P* value < 0.05.
Abbreviations: OR, odds ratio; CI, confidence interval; CRRT, continuous renal replacement therapy; Lac, lactic acid; CAD, coronary artery disease; LEVF, left ventricular ejection fraction.

Discussion

To our knowledge, this is the first study to describe a significant relationship between impaired hydration status and mortality in patients with acute type A aortic dissection. The results of this study showed that patients with A AAD with high serum osmotic pressure (>295mmol/L) at admission were significantly associated with an increased risk of in-hospital mortality, and that high serum osmotic pressure (impending and current dehydration) remained independently associated with in-hospital mortality after adjustment for other factors. Arevalo et al reported in patients with heart failure that high osmotic pressure was associated with increased mortality and readmitted hospital admission, but the effect of low osmotic pressure was not significant.[21]

The results of this study showed that patients with A AAD in the impending and current dehydration groups (>295mmol/L) were able to independently predict in-hospital death, which remained significant after multivariate adjustment for the effects of albumin, CRRT, smoking, lactic acid and other factors (P<0.05). A patients with A AAD usually require emergency surgical intervention, and postoperative survival remains poor. In this study, the postoperative patient mortality rate was 18.4%, which was approximately consistent with clinical statistics.[4] Many studies have confirmed that high serum osmolality may be associated with poor prognosis.[13] We also found that the mortality rate of A AAD patients in the impending and current dehydration group was significantly higher than that in the euhydration group, and the condition of high osmotic pressure was unfavorable for clinical results (Figure 2), which was consistent with some research results.[12–14] The reasons may be as follows: first, changes in hyperosmolality are always accompanied by increases in its main components, such as hypersodium and hyperglycemia,[22] which have been reported as risk factors for increased cardiac mortality in patients, respectively. Mortality can be predicted based on specific disorders of certain laboratory parameters at the time of an emergency, often referred to as a "aggregation" effect.[23] Second, high osmotic pressure may cause the redistribution of body fluids, such as fluid accumulation into the effective circulation volume, thus increasing the cardiac preload, leading to a worse outcome. Third, changes in cell hydration may be a key factor in determining cell swelling or contraction, affecting the integrity of cell structure and function until apoptotic cell death.[24] Nag et al also reported in their study that higher serum osmotic pressure on admission was associated with early death and worse prognosis,[13] which was also confirmed by Bhalla et al 's study,[25] providing theoretical evidence for this study. At the same time, this study also found this correlation (see Table 5). Overall, these results suggest that serum osmotic pressure has clinical significance in the development of A AAD and is an early prognostic factor for A AAD. Actively improving the hydration status of patients upon admission may be a new strategy for improving hospital survival of patients with A AAD in the future.

Another finding of this study was that we compared the differences in hospitalization outcomes between groups with different hydration states and found that mechanical ventilation and duration of stay in the ICU were significantly higher in A AAD patients (hyperoosmotic pressure) in the impending and current dehydration groups (see Table 3). High osmotic pressure has a negative effect on mechanical ventilation, which may be caused by the reduced response of ventilators to metabolic acidosis under high osmotic pressure conditions.[21] This is consistent with the cross-sectional findings of Pogson et al.[26] However, another clinical investigation is paradoxical, showing that hypernatremia reflects the effect of osmotic pressure to some extent and is not associated with ICU mortality in patients with respiratory diseases.[27] This may be related to the complex regulation mechanism between serum osmotic pressure and lung function. In an earlier clinical trial of resuscitation of pre-hospital traumatic hypotension, hypertonic saline/dextran was found to be less common in acute lung injury than normal saline.[27] Administration of hypertonic saline can lead to hyperosmosis, save the inhibition of T cells by traumatic anti-inflammatory mediators, inhibit neutrophilic activation and reduce macrophage migration, preserve alveolar surfactants and weaken pulmonary neutrophilic isolation, thereby improving lung injury.[28] In addition, many studies have also shown that high osmotic pressure has a protective effect on the lung,[26,29] which is different from our previous cognition. Of course, this needs to be verified by more prospective controlled studies in the future.

This study also found that high osmotic pressure had a significant adverse effect on postoperative AKI in patients with A AAD, and the incidence was significantly higher than that in the normal group (see Table 4). In the study of Farhan et al, high serum osmotic pressure was positively correlated with the risk of postoperative AKI in patients

receiving PCI,[30] and the incidence of AKI increased significantly with the increase of osmotic pressure, which was consistent with the results of this study. It is worth noting that there is A certain heterogeneity between the patients we included in A AAD surgery and PCI patients. However, in all studies, high serum osmolality was associated with an increased risk of long-term death, even after adjusting for baseline risk.[12–14,31] This study is no exception, and the correlation between the two may not be independent of AKI, suggesting that the increased mortality associated with high osmotic pressure may be driven by the increased occurrence of postoperative AKI in patients with A AAD. The two are mutually reinforcing, which is worth further exploration.

What merits our special attention in this study is the question of how patients with A AAD transition from a hypovolemic state to a hypervolemic state. Because of the limitation of retrospective study for how to deal with this situation, the part of the data is blank at present. Studies by others have illustrated that the ideal treatment for this condition at the time of emergency admission in patients with A AAD has not been established.[32] This blood volume conversion process is complex and needs to be comprehensively considered according to the body condition of the A AAD patient and the needs of the surgical procedure. Therefore, how to better cooperate with clinicians and anesthesiologists to adjust and deal with the impaired hydration status of patients during the operation and monitor closely after the operation are the areas that we need to explore in the future research.

In clinical practice, for a single serum indicator, it may only reflect severe organ dysfunction or a disturbance of the overall homeostasis mechanism, especially sodium, glucose and urea. The strength of this study is that serum osmolality is an easily calculated measure based on data that is generally available for most hospitalized patients. The advantage of osmotic pressure calculations is that there is a good balance between simplicity and clinical practicality. In this study, calculated serum osmolality was used and an attempt was made to combine these variables in the calculation to predict postoperative hospitalization mortality in patients with A AAD (see Table 5). All of these parameters are readily available to clinicians, and by defining a group with a much higher risk of death, the impact of an intervention can focus on investigating the impact of treatment on outcomes in that group. As an important supplement for clinical prognostic markers, it has great clinical significance. Online versions of the algorithms described in this report may be helpful in aiding clinical decision making.

Limitation

The study still has some limitations. First, we conducted a single-center retrospective analysis with a relatively small sample size, subsequent studies with larger samples are needed to support our conclusions. Secondly, because the data are from a retrospective study, it is not possible to effectively obtain the data of the conversion of A AAD patients from hypovolemic to hypervolemic state. Future research should continue to explore and explore effective conversion methods and their safety. Finally, in future prospective studies, low osmolality can be classified to facilitate the analysis of the effects of different osmolality levels on the postoperative prognosis of patients with A AAD, and to provide more clinical basis for medical staff to make clinical decisions.

Conclusions

The present study shows that high serum osmotic pressure is an independent predictor of in-hospital mortality in patients undergoing A AAD surgery, providing novel and robust evidence for a relationship between high serum osmotic pressure and the risk of death in patients undergoing A AAD surgery.

Acknowledgments

Funding

Disclosure

The authors report no conflicts of interest in this work.

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