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Impact of preoperative hyperuricemia on the prognosis of patients with acute type A aortic dissection

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ABSTRACT

Background: The mortality of patients with acute type A aortic dissection remains high, and it is imperative to explore the risk factors that affect patient prognosis.
Methods and results: 485 patients with acute type A aortic dissection who underwent surgery were included in our study. Based on preoperative serum uric acid tests, the patients were divided into two groups. After adjusting baseline data (SMD < 0.1), the 30-day mortality (19.4 % vs 6.2 %, $P < 0.001$) in the hyperuricemia group were significantly higher. Univariate and multivariate COX regression revealed that hyperuricemia was an independent risk factor for 30-day mortality in patients (HR, 2.2; $P = 0.016$). In subgroup analysis, the trend of increased mortality in the hyperuricemia group was consistent. In a median follow-up time of 6.2 years, Landmark analysis showed that the mortality of the hyperuricemia group mainly increased significantly within 1 month after surgery (Log-rank $P < 0.001$), and there was no significant difference after 1 month (Log-rank $P = 0.506$). Through restricted cubic spline, it was found that the risk of death gradually increases with preoperative blood uric acid levels above 330 μmol/L.
Conclusion: Preoperative hyperuricemia was an independent risk factor for early mortality in patients with acute type A aortic dissection, but it did not affect the mid-term survival in patients who survived the early post-operative period.

1. Introduction

The cardiorenal syndrome has received increasing attention from researchers in recent years, as it reflects the mutual influence of heart and kidney function in various diseases. Uric acid is the final product of purine metabolism, mainly metabolized by the kidneys. Serum uric acid (SUA) has been proven to serve as a biomarker for early changes in renal function [1,2]. Due to the loss of uricase activity, humans have higher levels of uric acid in their bodies compared to other mammals, making them more prone to developing hyperuricemia [3]. Hyperuricemia is associated with various cardiovascular diseases, including hypertension, coronary heart disease, heart failure among others [4–6]. Recent basic research has found that hyperuricemia may induce macrophage inflammation and lead to the development of thoracic aortic aneurysm and dissection, while treatment with allopurinol to reduce SUA can inhibit the formation of thoracic aortic aneurysm and dissection in mice [7,8]. However, there is still a lack of research on the relationship between hyperuricemia and clinical outcomes in patients with aortic dissection.

Aortic dissection, especially acute type A aortic dissection (ATAAD), is a very dangerous cardiovascular emergency. After onset, the mortality rate of patients increases by 1 % per hour, and the hospitalization

Abbreviations: ATAAD, acute type A aortic dissection; CABG, combined coronary artery bypass grafting; SUA, serum uric acid; ICU, intensive care unit; IPTWS, stabilized inverse probability of treatment weighting; PS, propensity score; SMD, standardized mean difference.

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mortality rate is as high as 22 % [9]. It is imperative to explore the risk factors that affect the prognosis of patients with acute type A aortic dissection. This cohort study aimed to analyze the impact of preoperative hyperuricemia on the prognosis of patients undergoing ATAAD surgery and explored the impact of preoperative hyperuricemia on early and mid-term mortality rates through propensity matching score, multivariate adjustment, and subgroup analysis. Restrictive cubic splines were used to explore the cut-off values between preoperative SUA and increased patient mortality rates.

2. Methods

2.1. Participants and study design

This retrospective observational cohort study recruited 632 patients with acute type A aortic dissection who underwent surgery at Beijing Anzhen Hospital from January 2015 to December 2017. 131 patients with missing preoperative imaging data and 16 patients with missing important baseline data were excluded, and ultimately 485 patients were included in this study. All patients were diagnosed with acute type A aortic dissection based on enhanced CT of the aorta. Hyperuricemia was defined as male SUA ≥ 420 μmol/L (7 mg/dL) or female SUA ≥ 360 μ mol/L[10]. We divided patients into a hyperuricemia group (N = 118) and a normal uric acid group (N = 367) based on preoperative serum uric acid results, and compared the impact of hyperuricemia on patient prognosis. The main endpoint event was death. All procedures involving human participants in this study were by the Declaration of Helsinki (revised 2013). The Ethics Committee of Beijing Anzhen Hospital approved the study (Institutional Review Board Document 2014019). The ethics committee waived the need for informed consent for each patient because the study was retrospective and did not involve patient-specific personal information. We present the content of the article according to the STROBE Checklist.

2.2. Data collection and variable definition

The Data were collected from the "A study of the prediction model for and interventions in Acute Aortic Syndrome (ChiCTR1900022637)" database. Data included patient demographics, medical history, imaging, procedural details, and postoperative outcomes [11]. ATAAD was defined as a dissection involving the ascending aorta with onset within 14 days [12]. All follow-up studies were conducted after the patient was discharged from the hospital for clinical or telephone follow-up. The early follow-up period was 30 days after discharge, and the mid-term follow-up deadline was December 12, 2022.

2.3. Surgical techniques

Surgical techniques have been described in previous articles [13,14]. All procedures were performed through a median sternal split. Proximal repair techniques were selected according to the degree of patient involvement in the dissection and included the Bentall procedure, Wheat procedure, ascending aortic replacement among others. Total arch replacement or hemi-arch replacement was selected based on the degree of patient involvement. The total arch replacement surgery was performed under conditions of moderate hypothermic circulatory arrest at around 25 °C and unilateral antegrade cerebral perfusion through right axillary artery catheterization.

2.4. Statistical analysis

Continuous variables with normal distribution were expressed as mean ± standard deviation and compared using the *t*-test. Continuous variables with non-normal distribution were expressed as median (interquartile spacing) and compared using the Mann-Whitney test. The categorical variable was expressed as a number (percentage) and was compared using the chi-square test or Fisher exact test as appropriate.

We used stabilized inverse probability of treatment weighting (IPTWs) based on propensity score (PS) to adjust the baseline data between the two groups. 16 patients were excluded due to missing important clinical variable data, while other patient data did not have missing data. We used multiple logistic regression analysis to calculate propensity scores. Hyperuricemia was the dependent variable, and the following factors were covariates: age, sex, Body Mass Index, hypertension, smoking, Ascending aorta diameter, history of stroke, and Aortic regurgitation. The weights of patients were calculated using the formula Pt/PS for the hyperuricemia group and (1-Pt)/(1-PS) for the normal group (Pt = the number of hyperuricemia group / total number). We used Standardized Mean Difference (SMD) to evaluate the balance between groups, with SMD < 0.1 indicating good baseline data balance after adjustment. We presented our article by the Reporting and Guidelines in Propensity Score Analysis [15].

We used the Kaplan-Meier method and log-rank test to compare patient survival rates and plotted survival curves. Landmark analysis was performed on follow-up data with a cutoff of one month after surgery to analyze the early and mid-term differences in patient mortality rates. The proportional hazards assumption was tested using Schoenfeld residuals, and no significant violations were detected (global p = 0.265). This confirms that the Cox regression model was appropriate for our data. We used univariable and multivariable Cox proportional hazards regression models to evaluate independent risk factors affecting patient mortality, and variables with p < 0.05 in the univariable Cox regression were included in the multivariable Cox regression analysis. A P-value of < 0.05 is considered statistically significant (2-sided). All the analyses were performed with the statistical software package R (https://www.R-project.org, The R Foundation).

3. Result

3.1. Baseline characteristics and operative details

Among 485 patients, 118 (24.3 %) had preoperative hyperuricemia. Before IPTWs, patients in the hyperuricemia group were younger (46.00 vs 49.00, P = 0.011), had a higher proportion of males (88.1 % vs 70.0 %, P = 0.001), and had a higher proportion of hypertension (60.2 % vs 46.0 %, P = 0.010, Table 1). After IPTWs, all baseline variables in both groups had good equilibrium (SMD < 0.1), and there was no significant difference in baseline data between the two groups (Fig. 1). In terms of surgical details, before IPTWs, patients with hyperuricemia had longer cardiopulmonary bypass time (215.50 vs 199.00, P = 0.009) and a lower proportion of root replacement (42.4 % vs 44.1 %, P = 0.036) and a higher proportion of combined CABG surgery (8.5 % vs 3.0 %, P = 0.022). After inverse probability weighting, only the proportion of patients who underwent combined CABG remained significantly different between the two groups (Table 1).

3.2. Early outcomes and mid-term follow-up of patients

Before IPTWs, patients with hyperuricemia had a higher 30-day mortality rate (16.1 % vs 6.5 %, P = 0.003), longer ICU time (2.33 vs 1.88, P = 0.022), and longer ventilator time (75.00 vs 42.00, P = 0.002). After IPTWs, there were still significant differences, and there were no significant differences in other postoperative complications (Table 2). We conducted mid-term follow-up on 389 patients (80.2 %) and conducted a landmark analysis using one month as the cutoff. It was found that the mortality rate of patients with hyperuricemia was significantly higher than that of the normal group within one month(log-rank, P < 0.001), and there was no significant difference in survival rate among patients after one month (log-rank, P = 0.506, Fig. 2). The Kaplan-Meier curve without landmark analysis is provided in Supplementary Fig. S1 for reference.

Table 1
Baseline characteristics and operative details.

Variables	Before IPTW			After IPTW		
	Hyperuricemia(n = 118)	Normal(n = 367)	P value	Hyperuricemia(n = 113.35)	Normal(n = 367.02)	P value
Age, y	46.00(37.25–53.75)	49.00(42.00–57.00)	0.011	47.88(39.00–56.58)	47.02(42.00–55.00)	0.693
Male, n (%)	104(88.1)	257(70.0)	0.001	88.1 (77.7)	273.4 (74.5)	0.075
Body mass index, kg/m2	27.02 (25.11–29.84)	25.39 (23.01–27.68)	0.619	25.65(24.49–27.73)	25.95(23.44–27.78)	0.521
Marfan syndrome, n (%)	1(0.8)	3(0.8)	1.000	2.0 (1.8)	2.5 (0.7)	0.391
Hypertension, n (%)	71 (60.2)	169 (46.0)	0.010	57.8 (51.0)	181.6 (49.5)	0.805
Diabetes mellitus, n (%)	3 (2.5)	10 (2.7)	0.990	3.1 (2.8)	9.5 (2.6)	0.928
Tobacco smoking, n (%)	46 (39.0)	121 (33.0)	0.278	39.8 (35.1)	126.7 (34.5)	0.918
History of cardiovascular disease, n (%)	4 (3.4)	19 (5.2)	0.585	5.3 (4.7)	18.8 (5.1)	0.870
History of stroke, n (%)	5 (4.2)	4 (1.1)	0.070	2.8 (2.5)	8.2 (2.2)	0.872
Ascending aorta diameter, mm	46.00(42.00–48.00)	46.00(42.00–50.00)	0.849	46.00(41.00–48.00)	46.00(42.00–49.00)	0.690
Congenital bicuspid aortic valve deformity, n (%)	2 (1.7)	7 (1.9)	0.992	1.3 (1.1)	8.2 (2.2)	0.450
Left ventricular ejection fraction, %	62.00(60.00–65.00)	62.00(60.00–65.00)	0.718	62.00(60.00–65.00)	62.00(60.00–65.00)	0.588
Aortic regurgitation, n (%)			0.254			0.960
None	50 (42.4)	146 (39.8)		46.0 (40.6)	148.7 (40.5)	
Mild	38 (32.2)	111 (30.2)		37.7 (33.3)	113.2 (30.8)	
Moderate	21 (17.8)	56 (15.3)		16.1 (14.2)	57.7 (15.7)	
Severe	9 (7.6)	54 (14.7)		13.5 (11.9)	47.5 (12.9)	
Surgery time, h	7.58(7.00–8.65)	7.58(7.00–8.00)	0.167	7.58(7.00–8.50)	7.58(7.00–8.17)	0.642
Cardiopulmonary bypass time, min	215.50(177.00–244.75)	199.00(171.00, 227.50)	0.009	210.16(175.00–245.00)	199.00 (172.00–230.00)	0.082
Cross-clamp time, min	114.50(95.25–138.75)	112.00(90.50, 135.00)	0.214	113.00(94.57–136.12)	112.00 (91.00–135.00)	0.411
Minimum operating temperature, °C	23.90(23.72–24.00)	23.90(23.65–24.00)	0.382	23.90(23.60–24.00)	23.90(23.60–24.00)	0.956
Root replacement, n (%)	50 (42.4)	162 (44.1)	0.036	51.7 (45.6)	156.4 (42.6)	0.617
Total arch replacement, n (%)	79 (66.9)	236 (64.3)	0.680	68.8 (60.7)	243.0 (66.2)	0.348
Combined CABG, n (%)	10 (8.5)	11 (3.0)	0.022	12.1 (10.6)	10.8 (2.9)	0.003
ASA anesthesia score	3.00 (3.00–4.00)	3.00 (3.00–4.00)	0.110	3.00(3.00–4.00)	3.00(3.00–4.00)	0.941

IPTWs stabilized the Inverse Probability of Treatment Weighting, CABG Coronary Artery Bypass Grafting.

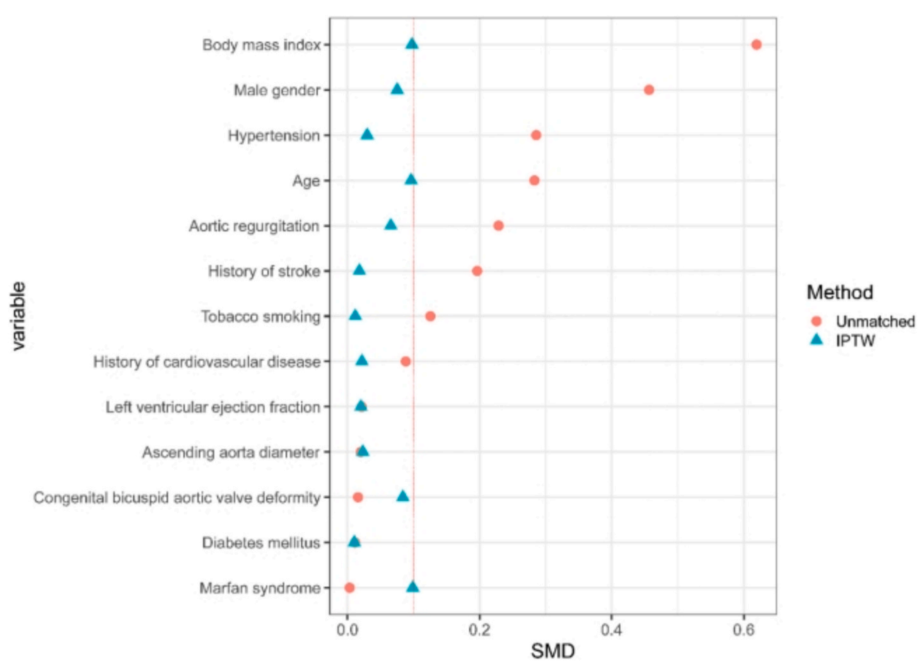

Fig. 1. Covariate balance IPTWs stabilized Inverse Probability of Treatment Weighting; SMD, standardized mean difference.

3.3. Risk factors of early survival

We conducted a univariate Cox regression on all factors that may affect early survival and included factors with $P < 0.05$ in the multivariate Cox regression. Preoperative hyperuricemia (HR, 2.16; 95 % CI, 1.15–4.05; $P = 0.016$), total arch replacement (HR, 2.82; 95 % CI, 1.09–7.33; $P = 0.033$), and combined CABG (HR, 2.68; 95 % CI, 1.03–6.97; $P = 0.043$) were independent risk factors for early mortality in patients. (Table 3).

3.4. Subgroup analysis and restricted cubic splines

In subgroup analysis based on different ages, sex, smoking, hypertension, ascending aorta replacement, and root replacement, the trend of increased mortality in the hyperuricemia group was consistent (Fig. 3). In subgroup analysis, no significant interaction was found

Table 2
Outcome characteristics.

Variables	Before IPTWs			After IPTWs		
	Hyperuricemia(n = 118)	Normal(n = 367)	P value	Hyperuricemia(n = 113.35)	Normal(n = 367.02)	P value
30 day mortality, n (%)	19 (16.1)	24 (6.5)	0.003	22.0 (19.4)	22.6 (6.2)	<0.001
Hemorrhagic stroke, n (%)	2 (1.7)	5 (1.4)	0.990	1.1 (1.0)	4.4 (1.2)	0.781
Ischemic stroke, n (%)	10 (8.5)	16 (4.4)	0.136	8.5 (7.5)	18.4 (5.0)	0.352
In hospital stay, d	13.00(9.00–17.00)	12.00(9.00, 16.00)	0.486	12.00(9.00–17.00)	12.00(9.00–16.00)	0.914
In ICU stay, d	2.33(1.18, 5.31)	1.88(1.01, 3.42)	0.022	2.46 (1.18–6.10)	1.90(1.01–3.42)	0.024
Ventilator time, h	75.00(28.00–220.00)	42.00 (24.00–87.75)	0.002	76.00(29.67–232.45)	42.00(24.00–90.00)	0.004
Dialysis, n (%)	16 (13.6)	35 (9.5)	0.286	16.4 (14.5)	33.8 (9.2)	0.140
Pneumonia, n (%)	5 (4.2)	11 (3.0)	0.719	4.1 (3.6)	12.8 (3.5)	0.956
Tracheotomy, n (%)	4 (3.4)	7 (1.9)	0.558	2.6 (2.3)	8.4 (2.3)	0.976
sepsis, n (%)	4 (3.4)	6 (1.6)	0.427	3.3 (2.9)	7.7 (2.1)	0.632

IPTWs stabilized Inverse Probability of Treatment Weighting; ICU, Intensive Care Unit.

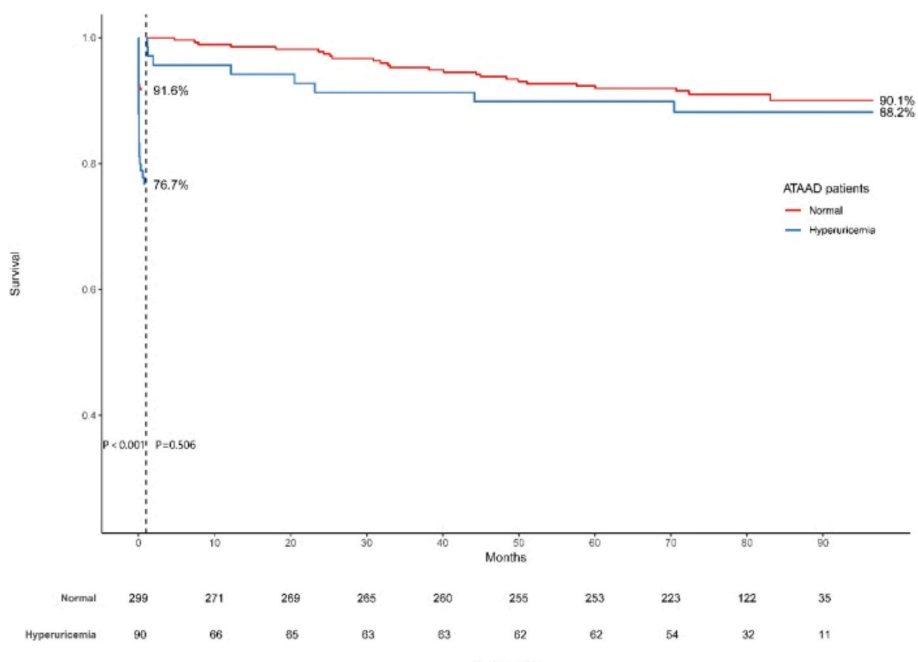

Fig. 2. Kaplan-Meier curve and landmark analysis: X line: follow-up time since surgery (months). Y line: rate of survival probability. ATAAD, type A aortic dissection.

between hyperuricemia and age (p-values for interaction = 0.437), sex (p-values for interaction = 0.599), smoking (p-values for interaction = 0.361), hypertension (p-values for interaction = 0.091), ascending aorta replacement (p-values for interaction = 0.054), or root replacement (p-values for interaction = 0.901). Through restricted cubic spline fitting, it was found that the risk of death gradually increases with the increase of preoperative serum uric acid levels after exceeding 330 μ mol/L. (Fig. 4).

4. Discussion

The main findings of this retrospective cohort study were as follows: 1. Through a median follow-up of 6.2 years, it was found that preoperative hyperuricemia only increased the 30-day mortality rate of patients with acute type A aortic dissection after surgery, and had no significant impact on the mid-term survival of patients who survived the early postoperative period. 2. Preoperative hyperuricemia was an independent risk factor for early mortality in patients with acute type A aortic dissection. In subgroup analysis, the trend of increased mortality in the preoperative hyperuricemia group was consistent across all subgroups. No significant interactions were found between hyperuricemia and any of the subgroup variables, including age, sex, smoking, hypertension, ascending aorta replacement, and root replacement (all p-values for interaction > 0.05). 3. Through restricted cubic spline analysis, it was found that the risk of death gradually increases in patients with preoperative serum uric acid levels exceeding 330 μmol/L.

Hyperuricemia is very common in the population, with a prevalence rate of over 20 % in the United States [16]. Serum uric acid has been confirmed by multiple studies to predict cardiovascular adverse events [17–19]. Recent studies found that serum uric acid levels were higher in patients with aortic dissection than in the control group, and hyperuricemia may be involved in the onset of aortic dissection [7,20]. Acute type A aortic dissection is a very dangerous cardiovascular emergency, and the mortality rate of patients increases by 1 % per hour after onset, with a hospital mortality rate of up to 22 % [9]. Yang et al. found a nonlinear correlation between serum uric acid levels and in-hospital mortality in patients with acute type A aortic dissection, with a positive correlation between serum uric acid levels above 260 μ mol/L and in-hospital mortality [21]. However, the study did not report on the condition of patients undergoing surgery. According to guidelines, these patients must immediately undergo emergency surgical treatment [12,22,23], and surgical factors might affect the conclusions of the study. Wang et al. studied 289 and found that preoperative uric acid albumin ratio was a risk factor for long-term survival. However, the follow-up time of this study was only one year, and patients may experience more early postoperative deaths [24]. Ma et al. found that postoperative uric acid could serve as a predictive factor for 30-day

Table 3
Univariable and Multivariable Risk Factors for 30-day mortality.

Variables	Univariable			Multivariable		
	HR	95 % CI	P value	HR	95 % CI	P value
Age	1.02	1.00–1.05	0.097			
Male gender	1.13	0.56–2.30	0.730			
Body mass index	0.98	0.91–1.06	0.686			
Hypertension	1.93	1.03–3.61	0.041	1.04	0.52–2.09	0.901
Diabetes mellitus	1.81	0.44–7.50	0.411			
Tobacco smoking	1.26	0.68–2.32	0.459			
Hyperuricemia	2.57	1.41–4.70	0.002	2.16	1.15–4.05	0.016
History of cardiovascular disease	1.60	0.49–5.16	0.434			
Ascending aorta diameter	1.00	0.96–1.05	0.892			
Congenital bicuspid aortic valve deformity	2.72	0.66–11.24	0.167			
Left ventricular ejection fraction	0.99	0.94–1.05	0.761			
Aortic regurgitation						
None						
Mild	1.16	0.56–2.37	0.691			
Moderate	1.31	0.56–3.06	0.533			
Severe	0.97	0.36–2.65	0.955			
Surgery time	1.36	1.13–1.64	0.001	1.12	0.91–1.38	0.295
Cardiopulmonary bypass time	1.00	1.00–1.00	0.136			
Cross-clamp time	1.01	1.00–1.01	0.080			
Minimum operating temperature	0.82	0.66–1.01	0.066			
Root replacement	0.60	0.32–1.14	0.122			
Total arch replacement	3.44	1.45–8.16	0.005	2.82	1.09–7.33	0.033
Combined CABG	4.93	2.19–11.07	0.000	2.68	1.03–6.97	0.043
ASA anesthesia score	1.51	0.94–2.43	0.087			

HR, hazard ratio; CI, Confidence interval; CABG, Coronary Angioplasty Bypass Grafting.

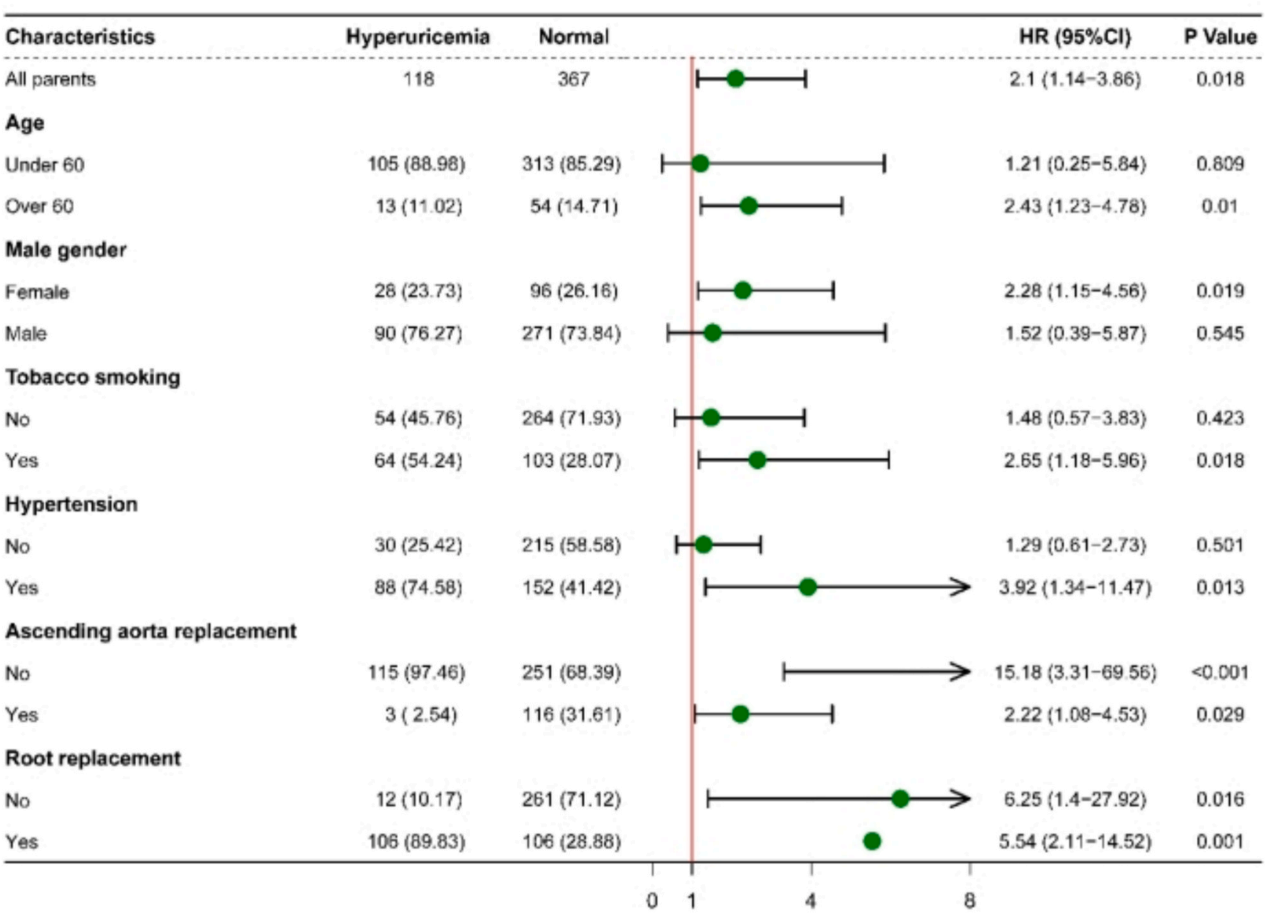

Fig. 3. 30 days mortality of hyperuricemia in subgroup analysis HR, hazard ratio; CI, Confidence interval.

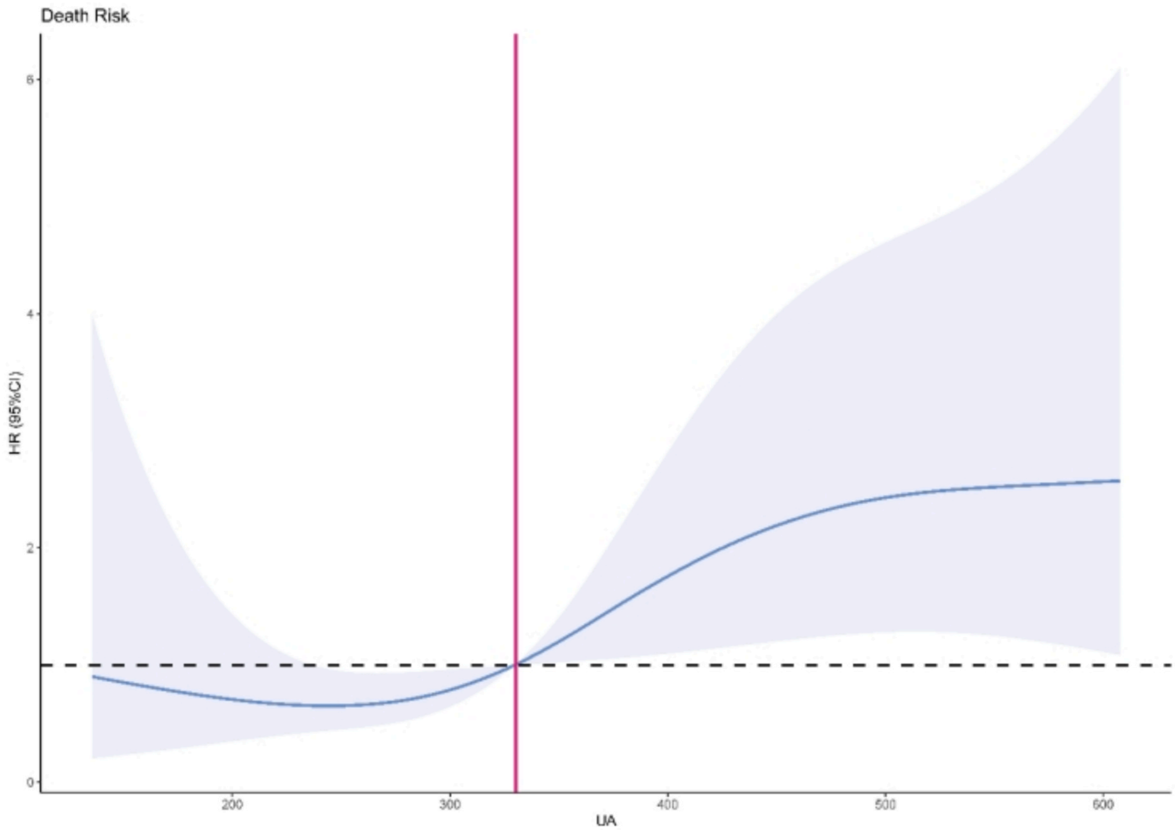

Fig. 4. Restrictive cubic spline analysis of preoperative serum uric acid levels and early mortality risk HR, hazard ratio; UA, uric acid.

postoperative mortality patients with acute type A aortic dissection who underwent surgical treatment, which might be more influenced by surgical factors [25]. In summary, there was still a lack of sufficient research on the impact of preoperative hyperuricemia on the early and mid-term prognosis of patients with acute type A aortic dissection who underwent surgical treatment.

Our study found that preoperative hyperuricemia was common in patients with acute type A aortic dissection who underwent surgery, and in our study, 24.3 % of patients had preoperative hyperuricemia. We ensured the reliability of statistical conclusions by using IPTWs to ensure that there was no significant difference in baseline data between the two groups of patients. In terms of surgical details, the hyperuricemia group only had more combined CABG, and there was no significant difference in other surgical variables. It might be attributed to the potential impact of long-term hyperuricemia on aortic root involvement. Preclinical studies have shown that hyperuricemia promotes elastic fiber degradation and aortic wall weakening [7], which could lead to more extensive involvement of the aortic root and subsequent coronary artery compromise. Although combined CABG is a known risk factor for postoperative mortality [26], preoperative hyperuricemia remained an independent predictor of early mortality in our multivariable analysis, underscoring its strong prognostic value. In terms of postoperative outcomes, patients with hyperuricemia had a higher 30-day mortality rate, and longer ICU and ventilator time after surgery, indicating that preoperative hyperuricemia might be associated with adverse post-operative outcomes in patients. Through a median follow-up of 6.2 years, we found that preoperative hyperuricemia only increased the 30-day mortality rate of patients undergoing surgery. For patients who survived the early postoperative period, hyperuricemia did not have a significant impact on their mid-term survival. Further research has confirmed that preoperative hyperuricemia remains an independent risk factor for early mortality in patients undergoing surgery, including surgical factors.

Liu et al. found that hyperuricemia could activate FcγR-mediated ERK1/2 phosphorylation to induce macrophage inflammation and ATAAD, therefore the hyperuricemia group might have a more fragile aortic structure due to long-term exposure to higher serum uric acid levels [7]. In addition, preoperative serum uric acid levels could predict the incidence of postoperative AKI [27], and an increase in preoperative serum uric acid levels may also be associated with poor organ perfusion caused by aortic dissection. In summary, there may be multiple reasons that lead to a decrease in early postoperative survival rate in patients with preoperative hyperuricemia, and the mechanism still needs further research. Previous studies have found a possible J-type relationship between serum uric acid levels and poor patient prognosis [28]. We found through restricted cubic splines that the risk of death gradually increases after preoperative blood uric acid levels exceed 330 μ mol/L, which is lower than the current diagnostic criteria for hyperuricemia. Therefore, our research results also suggested that the surgical risk of patients should be identified earlier. When the preoperative serum uric acid level of patients exceeds 330 μ mol/L, the risk of early postoperative death will increase.

Our findings indicate that preoperative hyperuricemia is an independent risk factor for early mortality in patients with ATAAD. We recommend that SUA levels be routinely measured in ATAAD patients as part of preoperative risk assessment. For patients with elevated SUA levels, close monitoring and tailored perioperative management may be warranted to mitigate the increased risk. Preclinical studies have demonstrated that hyperuricemia promotes aortic wall degradation, and urate-lowering therapy inhibits these processes in animal models [7]. While our study did not directly investigate the effects of urate-lowering therapy, these findings suggest that preoperative management of hyperuricemia could improve outcomes in high-risk patients. Additionally, for patients with aortic aneurysms and hyperuricemia, early initiation of urate-lowering therapy may reduce the risk of aortic adverse events. Future studies are needed to evaluate the potential benefits of SUAlowering strategies in these populations.

Our research had some limitations. Firstly, this was a single-center retrospective study, and there might be selection bias in patient selection. However, we used IPTWs to ensure comparability between the two groups of patients and conducted a sensitivity analysis using multivariate COX regression, subgroup analysis, and other statistical methods to reduce the impact of confounding factors. Secondly, we were unable to eliminate the impact of medication received by patients on preoperative serum uric acid levels. Additionally, due to the retrospective nature of the study, there might be other confounding factors that were not included in our study. Finally, there was a certain loss of follow-up rate in our mid-term follow-up, which might underestimate the mortality rate of patients during the mid-term follow-up period.

5. Conclusion

Preoperative hyperuricemia only increased the 30-day postoperative mortality rate in patients with acute type A aortic dissection and had no significant impact on the mid-term survival of patients. Preoperative hyperuricemia was an independent risk factor for early mortality in patients undergoing surgery. The risk of death gradually increased in patients with preoperative serum uric acid exceeding 330 μmol/L.

6. Statement of authorship

This author takes responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

CRediT authorship contribution statement

Songhao Jia: Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Methodology, Formal analysis, Data curation. **Maozhou Wang:** Writing – review & editing, Writing – original draft, Resources, Methodology, Data curation. **Meili Wang:** Writing – review & editing, Visualization, Validation, Supervision. **Wei Luo:** Writing – review & editing, Visualization, Validation, Supervision. **Yuyong Liu:** Writing – review & editing, Visualization, Validation, Supervision. **Wenjian Jiang:** Writing – review & editing, Validation, Supervision, Resources. **Hongjia Zhang:** Writing – review & editing, Visualization, Validation, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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References

[1] X. Tang, L. Xu, R.G. Meng, et al., Association between serum uric acid and the early marker of kidney function decline among Chinese middle-aged and older population: evidence from the china health and retirement longitudinal study [J], Biomed. Environ. Sci. 36 (3) (2023) 231–240, https://doi.org/10.3967/bes2023.026.
[2] M. Kuwabara, P. Bjornstad, I. Hisatome, et al., Elevated serum uric acid level predicts rapid decline in kidney function [J], Am. J. Nephrol. 45 (4) (2017) 330–337, https://doi.org/10.1159/000464260.
[3] S. Wen, H. Arakawa, I. Tamai, Uric acid in health and disease: from physiological functions to pathogenic mechanisms [J], Pharmacol. Ther. 256 (2024) 108615, https://doi.org/10.1016/j.pharmthera.2024.108615.
[4] M. Gaubert, T. Bardin, A. Cohen-Solal, et al., Hyperuricemia and hypertension, coronary artery disease, kidney disease: from concept to practice [J], Int. J. Mol. Sci. 21 (11) (2020), https://doi.org/10.3390/ijms21114066.
[5] S.Y. Kim, J.P. Guevara, K.M. Kim, et al., Hyperuricemia and coronary heart disease: a systematic review and meta-analysis [J], Arthritis Care Res (Hoboken) 62 (2) (2010) 170–180, https://doi.org/10.1002/acr.20065.
[6] H. Huang, B. Huang, Y. Li, et al., Uric acid and risk of heart failure: a systematic review and meta-analysis [J], Eur. J. Heart Fail. 16 (1) (2014) 15–24, https://doi.org/10.1093/eurjhf/hft132.
[7] L. Yang, H. Wu, C. Luo, et al., Urate-lowering therapy inhibits thoracic aortic aneurysm and dissection formation in mice [J], Arterioscler. Thromb. Vasc. Biol. 43 (6) (2023) e172–e189, https://doi.org/10.1161/atvbaha.122.318788.
[8] J. Chen, X. Zhang, H. Yao, et al., Causal association between uric acid levels and the risk of aortic aneurysm and aortic dissection: A two-sample Mendelian randomization study [J], Nutr. Metab. Cardiovasc. Dis. 34 (2) (2024) 515–520, https://doi.org/10.1016/j.numecd.2023.10.020.
[9] L.A. Pape, M. Awais, E.M. Woznicki, et al., Presentation, Diagnosis, and Outcomes of Acute Aortic Dissection: 17-Year Trends From the International Registry of Acute Aortic Dissection [J], J. Am. Coll. Cardiol. 66 (4) (2015) 350–358, https://doi.org/10.1016/j.jacc.2015.05.029.
[10] A. Maloberti, C. Giannattasio, M. Bombelli, et al., Hyperuricemia and risk of cardiovascular outcomes: the experience of the URRAH (Uric acid right for heart health) project [J], High Blood Press Cardiovasc. Prev. 27 (2) (2020) 121–128, https://doi.org/10.1007/s40292-020-00368-z.
[11] S. Jia, M. Wang, Y. Liu, et al., Effect of asymptomatic common carotid artery dissection on the prognosis of patients with acute type a aortic dissection [J], J. Am. Heart Assoc. 13 (1) (2024) e031542, https://doi.org/10.1161/jaha.123.031542.
[12] Erbel R, Aboyans V, Boileau C, et al. 2014 ESC Guidelines on the diagnosis and treatment of aortic diseases: Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult. The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC) [J]. Eur Heart J, 2014, 35(41): 2873-926. doi: 10.1093/eurheartj/ehu281.
[13] S.W. Chen, Y. Chen, W.G. Ma, et al., Limited vs. extended repair for acute type I aortic dissection: long-term outcomes over a decade in Beijing Anzhen Hospital [J], Chin. Med. J. (Engl.) 134 (8) (2021) 986–988, https://doi.org/10.1097/cm9.0000000000001416.
[14] L. Sun, R. Qi, J. Zhu, et al., Total arch replacement combined with stented elephant trunk implantation: a new "standard" therapy for type a dissection involving repair of the aortic arch? [J], Circulation 123 (9) (2011) 971–978, https://doi.org/10.1161/circulationaha.110.015081.
[15] X.I. Yao, X. Wang, P.J. Speicher, et al., Reporting and guidelines in propensity score analysis: a systematic review of cancer and cancer surgical studies [J], J. Natl Cancer Inst. 109 (8) (2017), https://doi.org/10.1093/jnci/djw323.
[16] M. Chen-Xu, C. Yokose, S.K. Rai, et al., Contemporary prevalence of gout and hyperuricemia in the united states and decadal trends: the national health and nutrition examination survey, 2007-2016 [J], Arthritis Rheumatol. 71 (6) (2019) 991–999, https://doi.org/10.1002/art.40807.
[17] M.E. Kleber, G. Delgado, T.B. Grammer, et al., Uric acid and cardiovascular events: a mendelian randomization study [J], J Am Soc Nephrol 26 (11) (2015) 2831–2838, https://doi.org/10.1681/asn.2014070660.
[18] L. Lu, X. Wu, J. Zhong, et al., Association between serum uric acid and cardiovascular fitness among US adults: a cross-sectional study [J], Heliyon 10 (5) (2024) e27169, https://doi.org/10.1016/j.heliyon.2024.e27169.
[19] X. Yan, J. Gong, Z. Wang, et al., Serum uric acid was non-linearly associated with the risk of all-cause and cardiovascular death in individuals with coronary heart disease: a large prospective cohort study [J], Front. Endocrinol. (Lausanne) 14 (2023) 1278595, https://doi.org/10.3389/fendo.2023.1278595.
[20] X. Li, S. Jiang, J. He, et al., Uric acid in aortic dissection: a meta-analysis [J], Clin. Chim. Acta 484 (2018) 253–257, https://doi.org/10.1016/j.cca.2018.06.002.
[21] G. Yang, X. Chai, N. Ding, et al., A retrospective observational study of serum uric acid and in-hospital mortality in acute type A aortic dissection [J], Sci. Rep. 12 (1) (2022) 12289, https://doi.org/10.1038/s41598-022-16704-3.
[22] Isselbacher E M, Preventza O, Hamilton Black J, 3rd, et al. 2022 ACC/AHA Guideline for the Diagnosis and Management of Aortic Disease: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines [J]. Circulation, 2022, 146(24): e334-e482. doi: 10.1161/cir.0000000000001106.
[23] L.F. Hiratzka, G.L. Bakris, J.A. Beckman, et al., ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with Thoracic Aortic Disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine [J], Circulation 1 (13) (2010) e266–e369, https://doi.org/10.1161/CIR.0b013e3181d4739e.

[24] X. Wang, C. Deng, F. Guo, et al., The preoperative uric acid-to-albumin ratio as a new indicator to predict long-term prognosis after surgery for patients with acute type a aortic dissection [J], Heart Surg. Forum 26 (1) (2023) E001–E8, https://doi.org/10.1532/hsf.5087.

[25] S. Ma, Q. Xu, Q. Hu, et al., Post-operative uric acid: a predictor for 30-days mortality of acute type A aortic dissection repair [J], BMC Cardiovasc. Disord. 22 (1) (2022) 411, https://doi.org/10.1186/s12872-022-02749-9.

[26] E. Neri, T. Toscano, U. Papalia, et al., Proximal aortic dissection with coronary malperfusion: presentation, management, and outcome [J], J. Thorac. Cardiovasc. Surg. 121 (3) (2001) 552–560, https://doi.org/10.1067/mtc.2001.112534.

[27] T. Kaufeld, K.A. Foerster, T. Schilling, et al., Preoperative serum uric acid predicts incident acute kidney injury following cardiac surgery [J], BMC Nephrol. 19 (1) (2018) 161, https://doi.org/10.1186/s12882-018-0970-x.

[28] S.P. Hsu, M.F. Pai, Y.S. Peng, et al., Serum uric acid levels show a 'J-shaped' association with all-cause mortality in haemodialysis patients [J], Nephrol. Dial. Transplant. 19 (2) (2004) 457–462, https://doi.org/10.1093/ndt/gfg563.