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ARTICLE

The Impact of Blood Pressure Rhythm and Perioperative Blood Pressure Variability on Short-Term Prognosis in Patients with Type A Aortic Dissection

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Abstract

Aims/Background Previous studies have indicated a strong correlation between disturbances in blood pressure (BP) circadian rhythm and major cardiovascular adverse events. Similarly, blood pressure variability (BPV) has been closely linked to cerebral small vessel disease and leukoaraiosis. This study aims to investigate the relationship between BP rhythm and BPV with the short-term prognosis of patients with Type A aortic dissection, offering insights for targeted perioperative nursing interventions and improving patient outcomes.

Methods This retrospective study included patients undergoing surgical treatment for Type A aortic dissection at Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences) from June 2022 to March 2024. The study followed patients from the completion of surgery to 30 days postoperatively, with all-cause mortality within 30 days as the endpoint representing poor short-term prognosis. Clinical data were compared along with: types of BP rhythm; BPV parameters including the mean 24-hour systolic BP (24hSBP), 24-hour diastolic BP (24hDBP), and pulse pressure; and the coefficient of variability (CV) for 24hSBP, 24hDBP, and pulse pressure. Multivariate logistic regression analysis was utilized to identify risk factors for poor short-term outcomes in these patients, and receiver operating characteristic (ROC) curves were plotted to assess the predictive value of BP rhythm types and BPV indicators.

Results The study ultimately included 115 participants, with 31 deaths occurring within 30 days post-surgery, resulting in a postoperative mortality rate of 26.96%. The multivariate logistic regression analysis revealed that white blood cell count, neutrophil count, non-dipping BP rhythm, pulse pressure, and the CV for 24hSBP, 24hDBP, and pulse pressure, were significant risk factors for poor short-term prognosis ($p < 0.05$). The ROC curve analysis demonstrated that non-dipping BP rhythm, pulse pressure, 24hSBP-CV, 24hDBP-CV, and pulse pressure-CV had areas under the curve (AUC) of 0.685, 0.749, 0.751, 0.773, and 0.763, respectively. The combination of these indicators yielded the highest AUC at 0.918.

Conclusion A combination of BP rhythm and BPV indicators provides significant predictive value for poor short-term outcomes in patients with Type A aortic dissection. Clinicians and nursing staff can use these features to formulate targeted preventive measures.

Key words: blood pressure rhythm; perioperative; blood pressure variability; Type A aortic dissection; short-term prognosis

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Introduction

Aortic dissection is a pathological process in which the inner layer of the aorta is torn, causing blood to enter the false lumen between the inner and outer layers of the aorta. This condition is life-threatening and usually requires urgent treatment. Acute aortic dissection (AAD) is characterized by a sudden tear in the aortic intima, allowing blood to enter the media layer. AAD is characterized by abrupt onset and rapid progression (Rylski et al, 2023). Based on the Stanford classification, acute aortic diseases are divided into Type A and Type B: Type A involves the ascending aorta, whereas Type B does not (Sorber and Hicks, 2022). According to incomplete statistics, the incidence of acute Type A aortic dissection is approximately 5–30 per million per year, with a trend of increasing incidence and a shift towards younger ages in recent years (Luehr et al, 2023). Type A aortic dissection also has one of the highest mortality rates within 24 hours of onset among all single diseases (Carbone et al, 2023). Currently, surgery is the primary treatment for patients with Type A aortic dissection (Frankel et al, 2020), but postoperative complications in various organs remain a significant factor affecting the quality of medical care for AAD, such as postoperative neurological damage (stroke, delirium, cognitive impairment), acute renal failure, and other renal complications. These complications, if they occur, can at best prolong hospital stays and at worst jeopardize patient safety (Zhu et al, 2020). Therefore, early assessment and prediction of the prognostic risk of patients with Type A aortic dissection are crucial for promoting postoperative recovery and enhancing the quality of nursing services.

Blood pressure (BP) rhythm plays an important role in cardiovascular diseases, especially in severe cases such as aortic dissection. BP rhythm refers to the fluctuation pattern of blood pressure in response to the day-night cycle. In normal individuals or those with mild hypertension, the BP rhythm follows a dipper curve, characterized by two peaks and one trough (Yang et al, 2019). Normal BP rhythms maintain stable function of the heart and vascular system. Previous study has confirmed a close association between disrupted blood pressure circadian rhythms and the onset and progression of chronic kidney disease (Zhang et al, 2022).

Blood pressure variability (BPV) refers to the degree of fluctuation in an individual's BP over a certain period. BPV reflects changes in the activity of the autonomic nervous system, which may be related to cardiovascular health. Larger variability may indicate that autonomic nervous regulation is unstable, which may affect the adaptability and stability of the cardiovascular system (Parati et al, 2018). A study has demonstrated that BPV is closely linked to cerebral small vessel disease, leukoaraiosis, and other brain disorders (Schutte et al, 2022). Increased BPV affects cerebral hemodynamics and causes significant arterial wall damage, leading to arteriosclerosis and increasing the risk of cardiovascular and cerebrovascular diseases. Recently, BPV has been recognized for its role in predicting complications such as cerebral small vessel disease (Parati et al, 2023) and cognitive impairments (Li et al, 2021). However, the impact of BP rhythm and BPV on the short-term prognosis of patients with Type A aortic dissection has not yet been reported in the literature. This study primarily investigates the relationship between BP rhythm and BPV and the short-term prognosis of patients with Type A aortic dissection, providing references for targeted perioperative nursing interventions and improving patient outcomes.

Methods

Study Subjects

This is a retrospective study. The research contents were in line with the Declaration of Helsinki and approved by the Medical Ethics Committee of Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences), Southern Medical University (Ethics Number: KY-X-2021-058-01). All subjects provided informed consent. Patients with Type A aortic dissection who underwent surgical treatment in Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences) from June 2022 to March 2024 were eligible for inclusion. Inclusion criteria included: (1) diagnosis of Stanford Type A aortic dissection confirmed by imaging; (2) met the surgical indications; (3) aged between 18 and 65 years; (4) onset to consultation time within 2 weeks; (5) complete case data. Exclusion criteria included: (1) history of cerebral infarction; (2) central nervous system diseases that could affect cognitive assessment, such as epilepsy or history of cranial trauma; (3) concomitant liver or renal failure; (4) concomitant malignancies, hematopoietic system diseases, or autoimmune diseases; (5) loss to follow-up. A total of 115 subjects were included in the study.

Data Collection

Clinical data for all patients at the time of enrollment were collected through the electronic medical record system, including basic information [gender, age, Body Mass Index (BMI), diabetes, hypertension, smoking history], laboratory data within 24 hours of admission [white blood cell count, neutrophil count, lymphocyte count, Platelet Count (PLT), cardiac troponin I, creatine kinase], echocardiographic indicators [Left Ventricular Ejection Fraction (LVEF), Left Ventricular End-Diastolic Diameter (LVEDD)], and perioperative data [surgical duration, cardiopulmonary bypass time, clamping time, deep hypothermic circulatory arrest time, ventilator usage time].

Assessment Methods for BP Rhythm and BPV

After admission, all patients underwent 24-hour ambulatory BP monitoring using a dynamic BP monitor. The mean $\pm$ standard deviation ($\bar{x} \pm$ s) was calculated for 24-hour systolic BP (24hSBP), 24-hour diastolic BP (24hDBP), and pulse pressure, where pulse pressure = 24hSBP – 24hDBP. The coefficient of variability (CV) for 24hSBP (24hSBP-CV), 24hDBP (24hDBP-CV), and pulse pressure (pulse pressure-CV) was calculated based on the means and standard deviations. BP circadian rhythm types were classified based on the nocturnal decrease in BP relative to daytime values as follows: riser (nighttime BP higher than daytime), extreme dipper (nighttime reduction exceeding 20%), non-dipper (nighttime reduction less than 10%), and dipper (nighttime reduction between 10% and 20%) (Algalarrondo et al, 2012).

Follow-Up Endpoints and Definitions

All patients were followed up from the end of surgical treatment to 30 days postoperatively, via medical record review or telephone consultations, to monitor all-cause mortality and postoperative adverse events within 30 days post-surgery. Postoperative adverse outcomes included acute kidney injury, delirium, acute stroke, and secondary postoperative bleeding occurring within 30 days. The endpoint event defining poor short-term prognosis was all-cause mortality within 30 days post-surgery.

Statistical Methods

SPSS27.0 (IBM Corp., Armonk, NY, USA) was used to analyze and process the data, and GraphPad Prism8 (GraphPad Software, Inc., San Diego, CA, USA) was used for drawing. The measurement data conforming to the normal distribution are expressed as ($\bar{x} \pm$ s), and the t test was used for comparison. The count data are expressed as 'cases' or '%', and the chi-square test, or chi-square test with correction for continuity, was used for comparison. Multivariate logistic regression analysis was used to analyze the risk factors of poor prognosis after operation. Receiver operating characteristic (ROC) curves were plotted to analyze the predictive value of BP rhythm and BPV indicators. $p < 0.05$ were considered statistically significant.

Results

Comparison of Basic and Laboratory Data between the Mortality and Survival Groups

A total of 115 patients were included in the study, of which 31 died within 30 days postoperatively (mortality group) and 84 survived (survival group), resulting in a postoperative mortality rate of 26.96%. Statistically significant differences were observed in white blood cell count and neutrophil count between the survival and mortality groups ($p < 0.05$). No significant differences were found in other parameters such as gender and age between the two groups ($p > 0.05$), as shown in Table 1.

Comparison of Echocardiographic Indicators and Perioperative Data between the Survival and Mortality Groups

There were no statistically significant differences in the echocardiographic indicators and perioperative data between the survival and mortality groups ($p > 0.05$), as shown in Table 2.

Comparison of BP Rhythm and BPV Indicators between the Survival and Mortality Groups

Significant differences were found between the survival and mortality groups in terms of BP rhythm types, pulse pressure, 24hSBP-CV, 24hDBP-CV, and pulse pressure-CV ($p < 0.05$). No significant differences were observed in the mean 24hSBP or 24hDBP between the two groups ($p > 0.05$), as shown in Table 3.

Table 1. Comparison of basic and laboratory data between the survival and mortality groups.

Item	Mortality group (n = 31)	Survival group (n = 84)	χ^2/t	p
Gender (n)			0.018	0.894
Male	24	66		
Female	7	18		
Age (years, $\bar{x} \pm$ s)	51.27 $\pm$ 5.33	49.48 $\pm$ 6.12	1.439	0.153
BMI (kg/m^2, $\bar{x} \pm$ s)	25.31 $\pm$ 1.85	25.27 $\pm$ 1.94	0.099	0.921
History of diabetes (n)			0.290	0.590
Yes	3	4		
N/A	28	80		
History of hypertension (n)			1.151	0.283
Yes	19	41		
N/A	12	41		
Smoking history (n)			1.842	0.175
Yes	15	29		
N/A	16	55		
White blood cell count ($\times 10^9$/L, $\bar{x} \pm$ s)	12.95 $\pm$ 3.12	11.18 $\pm$ 2.95	2.811	0.006
Neutrophil count ($\times 10^9$/L, $\bar{x} \pm$ s)	10.69 $\pm$ 1.21	9.88 $\pm$ 1.95	2.161	0.033
Lymphocyte count ($\times 10^9$/L, $\bar{x} \pm$ s)	0.92 $\pm$ 0.15	0.87 $\pm$ 0.19	1.320	0.190
PLT ($\times 10^9$/L, $\bar{x} \pm$ s)	178.44 $\pm$ 55.63	177.95 $\pm$ 56.28	0.042	0.967
Troponin I (µg/L, $\bar{x} \pm$ s)	3.05 $\pm$ 0.84	2.96 $\pm$ 0.95	0.464	0.643

BMI, Body Mass Index; PLT, Platelet Count.

Multivariate Logistic Regression Analysis for Poor Short-Term Prognosis in Patients with Type A Aortic Dissection

Variables that showed significant differences in the univariate analysis were included as independent variables in multivariate logistic regression analysis, with mortality of Type A aortic dissection patients as the dependent variable. The analysis revealed that white blood cell count, neutrophil count, non-dipper BP rhythm, pulse pressure, 24hSBP-CV, 24hDBP-CV, and pulse pressure-CV were significant risk factors for poor short-term prognosis in patients with Type A aortic dissection ($p < 0.05$), as shown in Table 4.

ROC Curve Analysis for Predicting Poor Short-Term Prognosis in Patients with Type A Aortic Dissection Using BP Rhythm and BPV Indicators

The results of the ROC curve analysis showed that the areas under the curve (AUC) for non-dipper BP rhythm, pulse pressure, 24hSBP-CV, 24hDBP-CV, and pulse pressure-CV was 0.685, 0.749, 0.751, 0.773, and 0.763, respectively, as shown in Table 5 and Fig. 1. The combined predictive value of these factors yielded the highest AUC at 0.918, with a sensitivity of 89.95% and specificity of 83.61%, as shown in Fig. 2.

Table 2. Comparison of echocardiographic indicators and perioperative data between the survival and mortality groups ($\bar{x} \pm s$).

Item	Mortality group (n = 31)	Survival group (n = 84)	t	p
LVEF (%)	66.89 ± 8.92	67.14 ± 9.55	0.127	0.899
LVEDD (mm)	47.88 ± 4.89	46.92 ± 5.15	0.899	0.371
Surgical duration (hours)	7.11 ± 0.89	6.84 ± 0.95	1.375	0.172
CPB time (minutes)	180.15 ± 42.63	167.65 ± 50.88	1.218	0.226
Clamping time (minutes)	100.12 ± 31.25	95.08 ± 36.77	0.678	0.499
DHCA time (minutes)	29.55 ± 5.18	27.49 ± 6.97	1.498	0.137
Ventilator usage time (hours)	61.02 ± 10.95	60.88 ± 11.46	0.059	0.953

LVEF, Left Ventricular Ejection Fraction; LVEDD, Left Ventricular End-Diastolic Diameter; CPB, Cardiopulmonary Bypass; DHCA, Deep Hypothermic Circulatory Arrest.

Table 3. Comparison of blood pressure (BP) rhythm and blood pressure variability (BPV) indicators between the survival and mortality groups.

Item	Mortality group (n = 31)	Survival group (n = 84)	χ^2/t	p
Blood pressure rhythm types (n)			11.123	0.011
Riser	9	21		
Extreme dipper	1	4		
Non-dipper	19	29		
Dipper	2	30		
24hSBP (mmHg, $\bar{x} \pm s$)	126.35 ± 13.88	121.77 ± 10.69	1.875	0.063
24hDBP (mmHg, $\bar{x} \pm s$)	74.15 ± 10.88	71.89 ± 8.26	1.191	0.236
Pulse pressure (mmHg, $\bar{x} \pm s$)	58.33 ± 6.89	50.12 ± 5.95	6.288	<0.001
24hSBP-CV	9.82 ± 1.77	7.74 ± 1.95	5.199	<0.001
24hDBP-CV	12.37 ± 2.95	10.71 ± 2.83	2.760	0.007
Pulse pressure-CV	15.62 ± 2.33	12.19 ± 2.64	6.853	<0.001

24hSBP, 24-hour systolic BP; 24hDBP, 24-hour diastolic BP; CV, coefficient of variability.

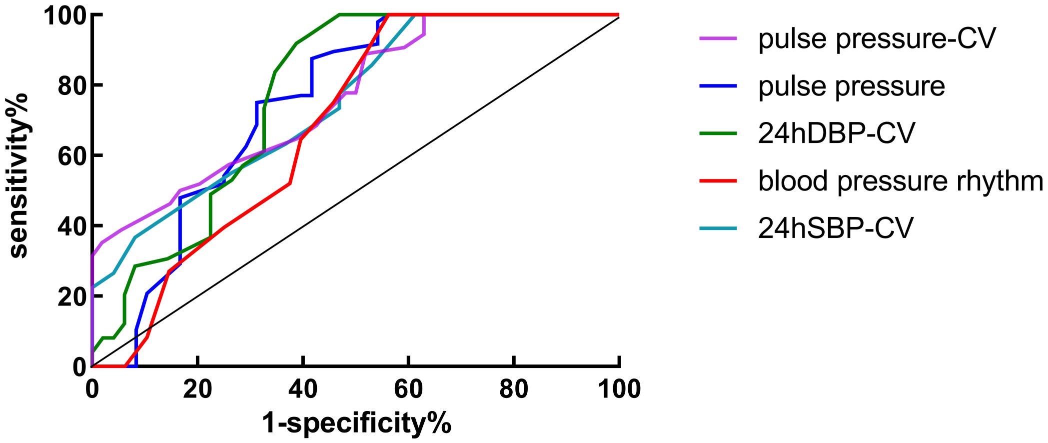

Fig. 1. Receiver operating characteristic (ROC) curves for predicting poor short-term prognosis in patients with Type A aortic dissection using BP rhythm and BPV indicators.

Table 4. Multivariate logistic regression analysis for poor short-term prognosis in patients with Type A aortic dissection.

Factor	β	SE	Ward χ^2	p	OR	95% CI
White blood cell count	0.749	0.205	13.351	<0.001	2.115	1.415–3.161
Neutrophil count	0.739	0.227	10.601	0.001	2.094	1.342–3.267
Non-dipper blood pressure rhythm	0.867	0.295	8.631	0.004	2.379	1.334–4.241
Pulse pressure	1.297	0.339	14.642	<0.001	3.659	1.883–7.111
24hSBP-CV	1.230	0.363	11.480	<0.001	3.421	1.679–6.969
24hDBP-CV	1.588	0.345	21.192	<0.001	4.895	2.489–9.625
Pulse pressure-CV	1.729	0.392	19.446	<0.001	5.633	2.613–12.146

Table 5. Receiver operating characteristic (ROC) curve analysis results of blood pressure rhythm and BPV index in predicting short-term poor prognosis of patients with Type A aortic dissection.

Factor	AUC	95% CI	Optimal cut-off value	Sensitivity (%)	Specificity (%)
Non-dipper blood pressure rhythm	0.685	0.575–0.795	-	64.58	60.42
Pulse pressure	0.749	0.647–0.850	53.7	87.50	60.33
24hSBP-CV	0.751	0.657–0.845	8.2	89.71	61.23
24hDBP-CV	0.773	0.676–0.869	10.5	90.76	63.27
Pulse pressure-CV	0.763	0.676–0.851	12.1	88.89	68.15
Combined	0.918	0.866–0.969	-	89.95	83.61

AUC, areas under the curve.

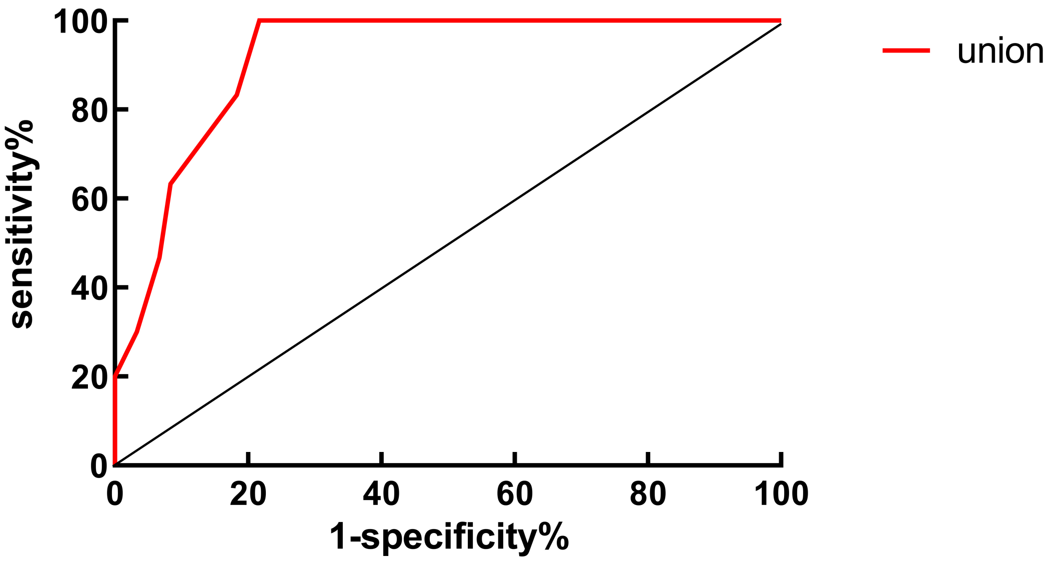

Fig. 2. ROC curves for predicting poor short-term prognosis in patients with Type A aortic dissection using combined BP rhythm and BPV indicators.

Discussion

With the increasing incidence of cardiovascular diseases such as hypertension, diabetes, and coronary artery disease, the prevalence of aortic dissection is also rising annually and increasingly affects younger populations (Elefteriades and Ziganshin, 2021). Aortic dissection is classified as Stanford Type A or Stanford Type B, with Type A being the most common. Characteristics of Type A include rapid onset, perilous conditions, and high morbidity and mortality rates (Bonaca and Reece, 2022). Surgery is considered the optimal treatment for aortic dissection, as it can reduce mortality, improve prognosis, and enhance clinical outcomes (Angleitner et al, 2022). Despite advancements in surgical techniques, the procedure remains complex, characterized by lengthy surgical times, extended use of ventilators, and postoperative respiratory complications. These factors increase the risk of multiorgan failure, leading to still low postoperative survival rates and suboptimal prognostic outcomes. In this study, 115 patients who met the inclusion criteria were followed postoperatively, with 31 deaths within 30 days post-surgery and 84 survivors, resulting in a postoperative mortality rate of 26.96%. This rate is higher than the 15.4% reported in the study by Abdelhameed et al (2020), but lower than the 32.11% found in the study by Pan et al (2024), likely due to variations in sample sources and regional differences.

Based on univariate and multivariate logistic regression analyses, this study identified white blood cell count, neutrophil count, non-dipper BP rhythm, pulse pressure, 24hSBP-CV, 24hDBP-CV, and pulse pressure-CV as significant risk factors for poor short-term prognosis in patients with Type A aortic dissection. Inflammation is closely linked to the occurrence and progression of aortic dissection. Research by Bedel and Selvi (2019) involving 96 patients with acute Type A aortic dissection found that compared to survivors, the mortality group showed a significant increase in white blood cell and neutrophil counts, while lymphocyte counts were notably decreased. Previous study has indicated that the distribution of white blood cells and their subtypes is regulated by the autonomic nervous system, with granulocytes expressing adrenergic receptors (Chen et al, 2020). The number and function of granulocytes are stimulated by the sympathetic nervous system. The occurrence of aortic dissection can trigger intense pain, leading to overactivation of the sympathetic nervous system and an increase in activated granulocytes, causing damage to the aortic wall tissue. Moreover, under the influence of chemotactic factors, neutrophils are mobilized into the peripheral blood, which may be detected as an increase in neutrophils during routine blood tests upon admission. One study showed that in riser and non-dipper blood pressure rhythms, insufficient nighttime BP reduction or paradoxical increases lead to higher morning peaks, potentially triggering microhemorrhages through hemodynamic mechanisms, thereby increasing the risk of hemorrhagic cerebrovascular diseases (Zhang et al, 2019). Abnormal BP rhythms directly cause an increase in BPV. BPV parameters dynamically reflect the cardiovascular system's capacity to regulate blood pressure. Under normal BPV conditions, the body can maintain stable BP through autonomic regulation, ensuring effective perfusion of the cardio-cerebrovascular system. Research by Song et al (2020) identified high levels of BPV as an independent risk factor for AAD. Related study suggests that BPV can cause significant fluctuations in BP, potentially exacerbating the extent of damage in aortic dissection, increasing the risk of aortic rupture or further dissection (Dai et al, 2023). Additionally, significant fluctuations in BP increase the load on the cardiac and vascular system, possibly leading to increased cardiac workload, myocardial ischemia, arrhythmias, and other complications, thereby affecting postoperative recovery and prognosis (Yang et al, 2021). In a single-center study spanning 11 years, Li et al (2023) found a close association between 24hSBP-CV and the occurrence of acute kidney injury postoperatively in patients with acute Type A aortic dissection. Similarly, research by Zhang et al (2015) indicated that high BPV is an independent predictor of postoperative mortality in patients with aortic dissection, aligning closely with the findings of this study.

This study further evaluated the predictive value of BP rhythm and indicators through ROC curve analysis. The results revealed that non-dipper BP rhythm, pulse pressure, 24hSBP-CV, 24hDBP-CV, and pulse pressure-CV predicted poor short-term prognosis in patients with Type A aortic dissection with AUC values of 0.685, 0.749, 0.751, 0.773, and 0.763, respectively. These findings suggest that both BP rhythm and BPV indicators are reliable predictors of adverse short-term outcomes following surgery in patients with Type A aortic dissection. Moreover, we found that the combination of these five indicators provided a higher AUC compared to using each index individually. This indicates that clinical healthcare professionals can use a combination of BP rhythm and BPV indicators to promptly identify patients with Type A aortic dissection who are at high risk of poor prognosis. Koba et al (2023) found that BPV reflects the regulatory state of the autonomic nervous system, which may have an important impact on vascular tone and cardiac load. In patients with Type A aortic dissection, the instability of the autonomic nervous system may lead to fluctuations in vascular tension, which in turn affects the progression and prognosis of the disease, consistent with the conclusions of this study.

The study proposes the following nursing strategies to address the risk factors for poor short-term prognosis in patients with Type A aortic dissection: (1) Blood Pressure Control: Healthcare providers should regularly monitor changes in the patient's BP, ensuring that the arterial pressure decrease does not exceed 20% to 30% of baseline values, and should maintain systolic pressure between 100 to 120 mmHg. Patients should be informed about the impact of emotional changes on BP and taught effective methods to alleviate stress and manage anxiety, which can help in reducing BP fluctuations. (2) Pain Management: When patients with aortic dissection experience pain, it is crucial to administer opioid medications as per doctor's orders promptly, avoiding injection at sites of scarring or edema to prevent the pain score from exceeding 3. Healthcare professionals should actively manage postoperative pain, and promote accelerated postoperative recovery with multimodal and individualized pain management approaches. Non-pharmacological pain relief methods, such as advising patients on comfortable positions and distraction techniques, should also be implemented. (3) Due to the effects of major surgery, patients with aortic dissection typically face certain activity restrictions for an extended period after discharge. Inflammatory markers and acute-phase proteins tend to increase with age, leading to chronic low-grade inflammation. Clinical staff should encourage patients to engage in regular, structured postoperative exercises, encourage smoking cessation and alcohol moderation, and ensure adherence to medical prescriptions and recommendations. These measures aim to reduce inflammation levels and BPV within the body, maintaining stable BP and thereby improving postoperative prognosis.

This study has certain limitations. It is based on single-center clinical research with a relatively small number of cases collected over a short period. Further multicenter studies involving larger populations would enhance the credibility of the results. Additionally, the neutrophil counts, BP rhythm, and BPV indicators are dynamically changing variables, and their results can be easily influenced by factors such as previous medication history, which could introduce a certain degree of bias into the findings. Finally, the follow-up period in this study was relatively short, and it did not extend to investigate medium- and long-term outcomes, which could be addressed in subsequent studies.

Conclusion

In conclusion, combining BP rhythm and BPV indicators was found to effectively predict poor short-term prognosis in patients with Type A aortic dissection. This approach provides new insights and tools for further refining the assessment of prognostic risks in patients with Type A aortic dissection. It aids clinical staff in rapidly evaluating patient prognosis based on BP rhythm and BPV indicators, thereby facilitating the timely development of effective targeted intervention strategies.

Key Points

- The white blood cell count and neutrophil count in the mortality group were significantly higher than those in the survival group.
- There were significant differences in BP rhythm type, pulse pressure, 24hSBP-CV, 24hDBP-CV and pulse pressure-CV between the survival group and the mortality group.
- Compared to vitamin K antagonists, direct oral anticoagulants had noticeably lower all-cause mortality and bleeding events.
- White blood cell count, neutrophil count, non-dipper BP rhythm, pulse pressure, 24hSBP-CV, 24hDBP-CV, pulse pressure-CV are risk factors for poor short-term prognosis in patients with Type A aortic dissection.
- The combined area under the curve for non-dipper BP rhythm, pulse pressure, 24hSBP-CV, 24hDBP-CV, and pulse pressure-CV displayed high predictive value for poor short-term prognosis in patients with Type A aortic dissection.

Availability of Data and Materials

The data used to support the findings of this study are available from the corresponding author upon request.

Author Contributions

YW participated in research design, data collection, and paper writing. WL, HW and BH conducted statistical analysis and supervision of the data. HZ and SC were responsible for data collection. HJ and WW were responsible for intervention implementation. All authors contributed to important editorial changes of important content in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study has been approved by the Medical Ethics Committee of Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences), Southern Medical University (Ethics Number: KY-X-2021-058-01). The entire experimental process follows the principle of informed consent, and patients or their families are provided with detailed explanations of the research content.

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Conflict of Interest

The authors declare no conflict of interest.

References

Abdelhameed AS, Xin F, Wei X. Early Mortality in Patients who Received Extensive Surgical Management for Acute Type A Aortic Dissection - Analysis of 452 Consecutive Cases from a Single-center Experience. Brazilian Journal of Cardiovascular Surgery. 2020; 35: 521–529. https://doi.org/10.21470/1678-9741-2019-0258

Algalarrondo V, Eliahou L, Thierry I, Bouzeman A, Dasoveanu M, Sebag C, et al. Circadian rhythm of blood pressure reflects the severity of cardiac impairment in familial amyloid polyneuropathy. Archives of Cardiovascular Diseases. 2012; 105: 281–290. https://doi.org/10.1016/j.acvd.2012.03.004

Angleitner P, Brinster DR, Gleason TG, Harris KM, Evangelista A, Bekeredjian R, et al. Type A Acute Aortic Dissection Presenting With Cerebrovascular Accident at Advanced Age. Seminars in Thoracic and Cardiovascular Surgery. 2022; 34: 805–813. https://doi.org/10.1053/j.semtcvs.2021.06.008

Bedel C, Selvi F. Association of Platelet to Lymphocyte and Neutrophil to Lymphocyte Ratios with In-Hospital Mortality in Patients with Type A Acute Aortic Dissection. Brazilian Journal of Cardiovascular Surgery. 2019; 34: 694–698. https://doi.org/10.21470/1678-9741-2018-0343

Bonaca MP, Reece TB. The prognostic implications of cardiac troponin in Type A aortic dissection and the challenge of understanding therapeutic consequences. European Heart Journal. Acute Cardiovascular Care. 2022; 11: 607–608. https://doi.org/10.1093/ehjacc/zuac093

Carbone A, Ranieri B, Castaldo R, Franzese M, Rega S, Cittadini A, et al. Sex differences in type A acute aortic dissection: a systematic review and meta-analysis. European Journal of Preventive Cardiology. 2023; 30: 1074–1089. https://doi.org/10.1093/eurjpc/zwad009

Chen Y, Lin Y, Zhang H, Peng Y, Li S, Huang X. Relationship of Platelet Counts and Inflammatory Markers to 30-Day Mortality Risk in Patients with Acute Type A Aortic Dissection. BioMed Research International. 2020; 2020: 1057496. https://doi.org/10.1155/2020/1057496

Dai A, Zhou Z, Jiang F, Guo Y, Asante DO, Feng Y, et al. Incorporating intraoperative blood pressure time-series variables to assist in prediction of acute kidney injury after type a acute aortic dissection repair: an interpretable machine learning model. Annals of Medicine. 2023; 55: 2266458. https://doi.org/10.1080/07853890.2023.2266458

Elefteriades JA, Ziganshin BA. A new 'angle' towards prediction of type A aortic dissection. European Journal of Cardio-Thoracic Surgery. 2021; 60: 987–988. https://doi.org/10.1093/ejcts/ezab270

Frankel WC, Green SY, Orozco-Sevilla V, Preventza O, Coselli JS. Contemporary Surgical Strategies for Acute Type A Aortic Dissection. Seminars in Thoracic and Cardiovascular Surgery. 2020; 32: 617–629. https://doi.org/10.1053/j.semtcvs.2020.06.025

Koba A, Yamagishi K, Sairenchi T, Noda H, Irie F, Takizawa N, et al. Risk Factors for Mortality From Aortic Aneurysm and Dissection: Results From a 26-Year Follow-Up of a Community-Based Population. Journal of the American Heart Association. 2023; 12: e027045. https://doi.org/10.1161/JAHA.122.027045

Li C, Ma Y, Hua R, Yang Z, Zhong B, Wang H, et al. Dose-Response Relationship Between Long-Term Blood Pressure Variability and Cognitive Decline. Stroke. 2021; 52: 3249–3257. https://doi.org/10.1161/STROKEAHA.120.033697

Li Y, Zheng T, Zhu J, Chen Y, Chen Y, Sun S. Variability of blood pressure and risk of postoperative acute kidney injury in patients undergoing surgery for acute aortic dissection: A 11-year single-center study. Journal of Clinical Hypertension. 2023; 25: 463–469. https://doi.org/10.1111/jch.14654

Luehr M, Yildiz M, Ma WG, Heck R, Polycarpou A, Jassar A, et al. Acute type A aortic dissection in adolescents and young adults under 30 years of age: demographics, aetiology and postoperative outcomes of 139 cases. European Journal of Cardio-Thoracic Surgery. 2023; 63: ezad112. https://doi.org/10.1093/ejcts/ezad112

Pan H, Shi Z, Wang S, Bai J, Zhang T. A predictive model of 30-day mortality in patients with acute type A aortic dissection. European Journal of Radiology. 2024; 175: 111469. https://doi.org/10.1016/j.ejrad.2024.111469

Parati G, Bilo G, Kollias A, Pengo M, Ochoa JE, Castiglioni P, et al. Blood pressure variability: methodological aspects, clinical relevance and practical indications for management - a European Society of Hypertension position paper*. Journal of Hypertension. 2023; 41: 527–544. https://doi.org/10.1097/HJH.0000000000003363

Parati G, Stergiou GS, Dolan E, Bilo G. Blood pressure variability: clinical relevance and application. Journal of Clinical Hypertension. 2018; 20: 1133–1137. https://doi.org/10.1111/jch.13304

Rylski B, Schilling O, Czerny M. Acute aortic dissection: evidence, uncertainties, and future therapies. European Heart Journal. 2023; 44: 813–821. https://doi.org/10.1093/eurheartj/ehac757

Schutte AE, Kollias A, Stergiou GS. Blood pressure and its variability: classic and novel measurement techniques. Nature Reviews. Cardiology. 2022; 19: 643–654. https://doi.org/10.1038/s41569-022-00690-0

Song C, Yu G, Feng X, Feng R, Bao J, Zhao Z, et al. Impact of high blood pressure variability on the occurrence of acute type B aortic dissection. Vascular. 2020; 28: 413–420. https://doi.org/10.1177/1708538120902630

Sorber R, Hicks CW. Diagnosis and Management of Acute Aortic Syndromes: Dissection, Penetrating Aortic Ulcer, and Intramural Hematoma. Current Cardiology Reports. 2022; 24: 209–216. https://doi.org/10.1007/s11886-022-01642-3

Yang G, Peng W, Zhou Y, He H, Pan X, Li X, et al. Admission Systolic Blood Pressure and In-hospital Mortality in Acute Type A Aortic Dissection: A Retrospective Observational Study. Frontiers in Medicine. 2021; 8: 542212. https://doi.org/10.3389/fmed.2021.542212

Yang WY, Melgarejo JD, Thijs L, Zhang ZY, Boggia J, Wei FF, et al. Association of Office and Ambulatory Blood Pressure With Mortality and Cardiovascular Outcomes. JAMA. 2019; 322: 409–420. https://doi.org/10.1001/jama.2019.9811

Zhang D, He M, He Q, Li Z. Blood Pressure Rhythm and Blood Pressure Variability as Risk Factors for White Matter Lesions: A Cross-Sectional Study. Medical Science Monitor. 2022; 28: e933880. https://doi.org/10.12659/MSM.933880

Zhang H, Cui Y, Zhao Y, Dong Y, Wang J, Duan D, et al. Association of Circadian Rhythm of Blood Pressure and Cerebral Small Vessel Disease in Community-Based Elderly Population. The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences. 2019; 74: 1322–1330. https://doi.org/10.1093/gerona/gly212

Zhang L, Tian W, Feng R, Song C, Zhao Z, Bao J, et al. Prognostic Impact of Blood Pressure Variability on Aortic Dissection Patients After Endovascular Therapy. Medicine. 2015; 94: e1591. https://doi.org/10.1097/MD.0000000000001591

Zhu Y, Lingala B, Baiocchi M, Tao JJ, Toro Arana V, Khoo JW, et al. Type A Aortic Dissection-Experience Over 5 Decades: JACC Historical Breakthroughs in Perspective. Journal of the American College of Cardiology. 2020; 76: 1703–1713. https://doi.org/10.1016/j.jacc.2020.07.061