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Prognostic value of admission base excess in postoperative outcomes of aortic dissection patients: a retrospective cohort analysis

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Purpose: The aim of this retrospective study was to evaluate the relationship between admission base excess and clinical outcomes in postoperative patients with aortic dissection.
Methods: Clinical data were extracted from the MIMIC-IV (Medical Information Mart for Intensive Care IV) database. The association between admission base excess and mortality in postoperative patients with aortic dissection was assessed using multivariate Cox regression and Kaplan-Meier survival analysis. Subgroup analysis and receiver operating characteristic (ROC) curve analysis were employed to evaluate the predictive performance of base excess for in-hospital, 30-day, 90-day, and 1-year mortality.
Results: A total of 196 patients were categorized into the normal base excess (–3 to +3 mmol/L) group and abnormal base excess (<–3 or >+3 mmol/L) group. Multivariate Cox regression analysis revealed that arterial base excess was a significant predictor of all-cause mortality across all periods. Subgroup analyses showed no significant interaction effects. The area under the ROC curve for base excess ranged from 0.640 to 0.745, indicating comparable predictive performance to existing scoring tools.
Conclusion: Arterial base excess measured at admission is an effective and accessible predictor of mortality in patients with aortic dissection following surgical treatment.
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Key Words: Acid-base balance, Aortic dissection, MIMIC-IV database, Mortality

INTRODUCTION

Aortic dissection, characterized by the development of an intimal tear, remains the most common aortic catastrophe [1]. According to the Stanford classification, type A aortic dissection involves the ascending aorta and/or aortic arch and may extend to the descending aorta, whereas type B dissection affects the descending aorta or aortic arch without involving the ascending aorta [2]. The annual incidence of aortic dissection is estimated to be 5.8 cases per 100,000 people in the United Kingdom and 2.8 cases per 100,000 people in China [3,4]. Emergent aortic replacement or repair surgery is typically required for survival [5]. However, a significant proportion of patients fail to survive hospital assessment, and among those who do, the mortality rate increases with an increase of 1% per hour after admission to the intensive care unit (ICU) [6]. Even for patients who undergo surgery, the in-hospital mortality rate remains as high as 27% [7]. Therefore, identifying factors associated with postoperative mortality is essential to assist surgeons in risk stratification for patients with aortic dissection.

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Metabolic acidosis, a condition characterized by reduced serum bicarbonate levels, decreased base excess, and blood pH acidification, often reflects organ dysfunction. This can be evaluated using arterial blood gas analysis. During the course of aortic dissection, organ malperfusion or perperfusion disturbances during cardiopulmonary bypass (CPB) may lead to either acidemia or alkalemia, both of which are associated with increased operative mortality [8,9]. Base excess, an indicator of metabolic acid-base balance, is unaffected by respiratory conditions and serves as a reliable measure of metabolic disturbances. Severe acidosis has been shown to strongly predict operative mortality in patients with aortic dissection, as evidenced by a retrospective chart review [10]. In this study, we aim to evaluate the prognostic significance of admission base excess levels and compare its performance with existing scoring tools in postoperative patients with aortic dissection using data from the Medical Information Mart for Intensive Care IV (MIMIC-IV) database.

METHODS

Data source

The MIMIC-IV (ver. 2.0) is a publicly available archival system established by the Massachusetts Institute of Technology (Cambridge, MA, USA) which contains detailed clinical data for patients treated at Beth Israel Deaconess Medical Center (Boston, MA, USA) between 2008 and 2019 [11]. To ensure privacy, all patient information has been de-identified, and informed consent was therefore waived. Credentialed access to the database was approved by the Institutional Review Board of the Massachusetts Institute of Technology (MIT) (authorization code. 13256990). The data files were downloaded from PhysioNet (https://physionet.org/content/mimiciv/2.2/) and extracted using Structured Query Language (SQL) and PostgreSQL tools (ver. 14) via Navicat Premium software (PremiumSoft CyberTech Ltd.).

Data extraction

From the MIMIC-IV database, an initial cohort of 858 patients diagnosed with aortic dissection was identified. Diagnostic codes from the International Classification of Diseases, 9th (ICD-9: 44100, 44101, 44102, 44103) and 10th Revisions (ICD-10: I71, I710, I7100, I7101, I7102, I7103) were used for identification. Patients who underwent open-chest surgery for aortic dissection—including procedures such as resection of vessels and replacement of the thoracic/abdominal aorta or descending/ascending/arch with a synthetic substitute—were further extracted. Cases of repeated hospitalization and patients

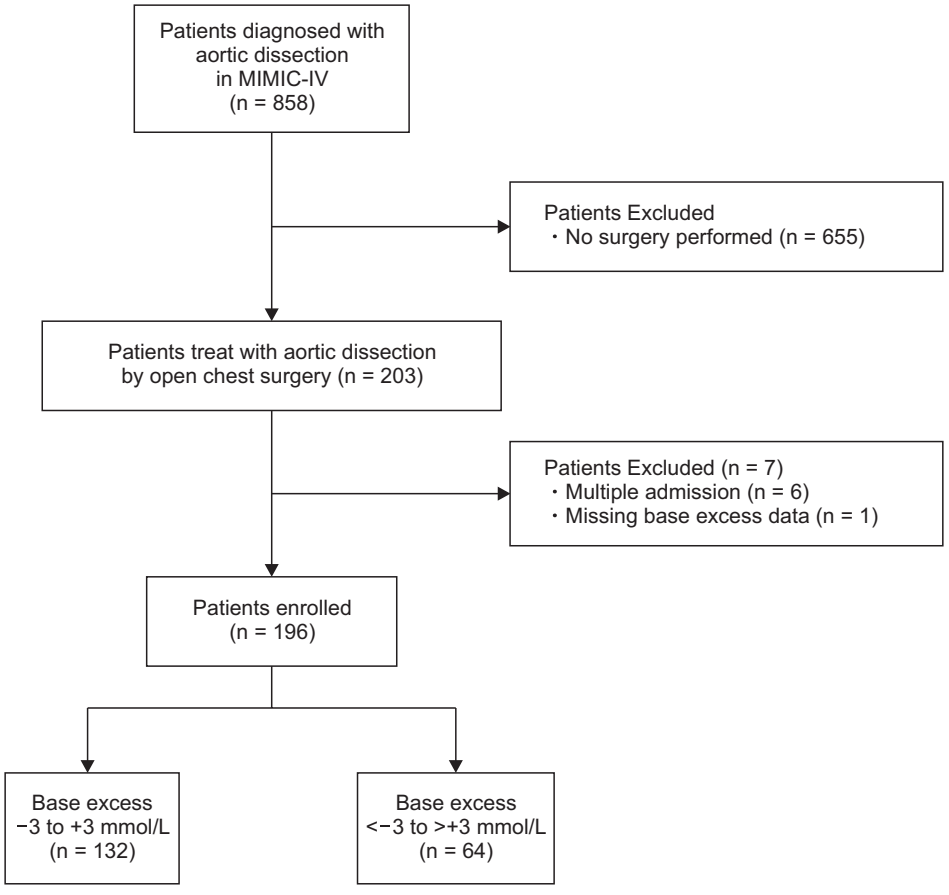

Fig. 1. Flow diagram of patient selection. MIMIC-IV, Medical Information Mart for Intensive Care IV.

without base excess were excluded. Ultimately, 196 patients met the inclusion and exclusion criteria for final analysis (Fig. 1). Preoperative and postoperative variables for these patients were extracted based on their subject_id.

The study included the following variables: (1) demographics (age, gender, ethnicity, and body mass index [BMI]); (2) vital signs (heart rate, blood pressure, respiratory rate, and percutaneous oxygen saturation [SpO_2]); (3) blood gas analysis (pH, anions gap, base excess); (4) comorbidities (e.g., atrial fibrillation, chronic obstructive pulmonary disease, diabetes mellitus, cerebrovascular disease, etc); (5) severity scores (Acute Physiology Score III [APSIII], Simplified Acute Physiology Score II [SAPSII], Sequential Organ Failure Assessment [SOFA] score, and Oxford acute severity of illness score [OASIS]); (6) vasopressor use (medications including dopamine, epinephrine, norepinephrine, phenylephrine, vasopressin, dobutamine, and milrinone); (7) postoperative outcomes (mechanical ventilation time, hospital length of stay, ICU length of stay, retransfer to ICU); and (8) survival status and death time in hospital. For patients with multiple vital signs and blood gas analyses, the first value after admission was collected. In cases of multiple operations for aortic dissection, data from the last hospital admission were included. Vasopressor use was analyzed during the perioperative period. Severity scores were recorded as the maximum value within the first 24 hours after surgery. The cohort was stratified into 2 groups based on base excess levels: a normal group (–3 to +3 mmol/L) and an abnormal group (<–3 or >+3 mmol/L). Mortality, defined as death during hospitalization, was designated as the primary endpoint.

Statistical analysis

Data processing and analysis were performed using R software ver. 4.2 (The R Foundation) and Zstats ver. 1.0 (www.zstats.net). Descriptive statistics were applied to both categorical and continuous variables. Categorical variables were represented as proportions and compared by the chi-square test or Fisher exact test. Normally distributed continuous variables were reported as medians with standard deviations and analyzed by the Student t-test, while abnormal distribution of continuous variables were presented as medians with interquartile ranges (IQRs) and compared by the Mann-Whitney U-test. The log-rank test was utilized to compare the Kaplan-Meier survival curves between the normal and abnormal base excess groups. Hazard ratios (HRs) with 95% confidence intervals (CIs) were reported for survival outcomes. Five multivariate Cox regression models were employed to explore the association between base excess and mortalities. In the unadjusted model 1, no confounders were considered. Model 2 was adjusted for age, gender, BMI, and ethnicity. Model 3 included the variables in model 1, as well as heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), respiratory rate, and SpO_2. Model 4 was

Table 1. Characteristics in patients with aortic dissection

Characteristic	Total (n = 196)	Abnormal (n = 64)	Normal (n = 132)	Statistic	P-value
Demographics					
Age (yr)	63.515 ± 13.612	62.047 ± 14.737	64.227 ± 13.031	–1.052[a]	0.294
Male	128 (65.3)	46 (71.9)	82 (62.1)	1.810[b]	0.179
Body mass index (kg/m^2)	27.442 (24.158–31.541)	27.548 (25.124–31.541)	27.434 (23.872–31.293)	–0.522[c]	0.602
Ethnicity				4.357[b]	0.225
White	107 (54.6)	33 (51.6)	74 (56.1)		
Black	21 (10.7)	4 (6.3)	17 (12.9)		
Hispanic	8 (4.1)	2 (3.1)	6 (4.5)		
Others	60 (30.6)	25 (39.1)	35 (26.5)		
Vital sign					
Heart rate (beats/min)	84 (75–89)	83 (74–90)	84 (770–89)	–0.179[c]	0.858
SBP (mmHg)	113.461 ± 18.659	113.673 ± 18.473	113.368 ± 18.813	0.101[a]	0.920
DBP (mmHg)	61.611 ± 11.918	61.564 ± 11.606	61.632 ± 12.099	–0.035[a]	0.972
Respiratory rate (breaths/min)	16 (14–18)	16 (14–18)	16 (14–18)	–1.240[c]	0.215
SpO_2 (%)	100 (97–100)	99 (95–100)	100 (98–100)	–2.612[c]	0.009

Table 1. Continued

Characteristic	Total (n = 196)	Abnormal (n = 64)	Normal (n = 132)	Statistic	P-value
Comorbidity					
Hypertension	157 (80.1)	52 (81.2)	105 (79.5)	0.079[b]	0.779
Heart surgery history	7 (3.6)	2 (3.1)	5 (3.8)	0.000[b]	>0.999
Atrial fibrillation	86 (43.9)	29 (45.3)	57 (43.2)	0.079[b]	0.778
Coronary artery disease	16 (8.2)	4 (6.2)	12 (9.1)	0.464[b]	0.496
Marfan syndrome	5 (2.6)	1 (1.6)	4 (3.0)	0.016[b]	0.898
Congestive heart failure	30 (15.3)	9 (14.1)	21 (15.9)	0.113[b]	0.736
Cerebrovascular disease	34 (17.3)	16 (25.0)	18 (13.6)	3.882[b]	0.049
COPD	17 (8.7)	5 (7.8)	12 (9.1)	0.089[b]	0.766
Diabetes mellitus	20 (10.2)	5 (7.8)	15 (11.4)	0.593[b]	0.441
Blood gas analysis					
pH	7.360 (7.290–7.410)	7.285 (7.205–7.370)	7.375 (7.340–7.410)	–5.609[c]	<0.001
Anion gap (mmol/L)	13 (11–15)	13 (11–18)	12 (11–15)	–1.783[c]	0.075
PaO_2/FiO_2 ratio	212.500 (138.250–315.750)	164.667 (101.107–261.500)	245.500 (161.750–335.750)	–3.985[c]	<0.001
Perioperative vasopressor use	160 (81.6)	50 (78.1)	110 (83.3)	0.780[b]	0.377
Dopamine	2 (1.0)	1 (1.6)	1 (0.8)	-[d]	0.548
Epinephrine	88 (44.9)	37 (57.8)	51 (38.6)	6.407[b]	0.011
Norepinephrine	76 (38.8)	31 (48.4)	45 (34.1)	3.737[b]	0.053
Phenylephrine	121 (61.7)	37 (57.8)	84 (63.6)	0.619[b]	0.431
Vasopressin	49 (25.0)	22 (34.4)	27 (20.5)	4.455[b]	0.035
Dobutamine	8 (4.1)	4 (6.2)	4 (3.0)	0.467[b]	0.494
Milrinone	34 (17.3)	20 (31.2)	14 (10.6)	12.812[b]	<0.001
Postoperative outcome					
Mechanical ventilation time (hr)	25.167 (10.188–89.229)	50.892 (11.750–162.438)	20.542 (10.000–53.804)	–2.209[c]	0.027
Length of stay (day)					
Hospital	11.213 (6.980–18.994)	13.573 (7.465–22.542)	10.393 (6.980–16.202)	–0.843[b]	0.399
Intensive care unit	5.625 (2.520–11.602)	7.050 (3.035–15.553)	5.155 (2.488–10.360)	–1.661[b]	0.097
Mortality					
In-hospital	27 (13.8)	17 (26.6)	10 (7.6)	–0.843[c]	<0.001
30-Day	26 (13.3)	16 (25.0)	10 (7.6)	–1.661[c]	<0.001
90-Day	31 (15.8)	20 (31.2)	11 (8.3)	13.082[b]	<0.001
1-Year	38 (19.4)	21 (32.8)	17 (12.9)	11.374[b]	<0.001
SOFA	10 (7–12)	11 (9–14)	9 (7–12)	17.001[b]	<0.001
APSIII	52.5 (38.75–76)	64 (49–89)	47 (35–70)	10.958[b]	<0.001
SAPSII	42.5 (36–50)	43 (38–49.5)	41 (35–51)	–3.946[c]	0.250
OASIS	38.783 ± 7.635	40.709 ± 6.265	37.936 ± 8.043	–3.642[c]	0.024

Values are presented as the mean ± standard deviation, number of patients (%) or median (interquartile range).
SBP, systolic blood pressure; DBP, diastolic blood pressure; SpO_2, percutaneous oxygen saturation; COPD, chronic obstructive pulmonary disease; PaO_2, partial pressure of oxygen in the arterial blood; FiO_2, fraction of inspired oxygen; SOFA, Sequential Organ Failure Assessment; APSIII, Acute Physiology Score III; SAPSII, Simplified Acute Physiology Score III; OASIS, Oxford acute severity of illness score.
Analyzed by [a]t-test, [b]chi-square test, [c]Mann-Whitney test, and [d]Fisher exact test.

adjusted for additional comorbidities. In addition, subgroup analysis was performed to evaluate HRs based on age (<70 or ≥70 years), BMI (<30 or ≥30), SpO_2 (<95 or ≥95%), mechanical ventilation time (<90 or ≥90 hours), vasopressin use (yes or no), epinephrine use (yes or no), and SOFA (<7 or ≥7). To reduce potential publication bias, a sensitivity analysis was conducted after excluding patients with missing data. All tests were 2-sided, with P-values of <0.05 considered statistically significant.

RESULTS

Baseline characteristics

In total, 196 patients underwent aortic surgery via the open approach and met the inclusion criteria in the MIMIC-IV database. Patients were classified according to their base excess levels: the normal group (–3 to +3 mmol/L) and the abnormal group (<–3 or >+3 mmol/L). The baseline characteristics of the enrolled patients, categorized by base excess levels, are summarized in Table 1. These characteristics include demographics, vital signs, blood gas analysis, comorbidities, severity cores, and postoperative outcomes.

Patients in the abnormal base excess group tended to have significantly lower levels of SpO_2, pH value, and PaO_2/FiO_2 ratio, along with a higher incidence of cerebrovascular disease compared to those in the normal base excess group. Moreover, patients with abnormal base excess were more likely to be administrated with a vasopressor, especially epinephrine, vasopressin, and milrinone (P = 0.011, P = 0.035, and P < 0.001, respectively). This group also had significantly longer ventilation time (50.892 hours [IQR, 11.750–162.438 hours] *vs.* 20.542 hours [IQR, 10.000–53.804 hours], P = 0.027) and higher SOFA scores (11 [IQR, 9–14] *vs.* 9 [IQR, 7–12], P < 0.001), APSIII scores (64 [IQR, 49–89] *vs.* 47 [IQR, 35–70], P < 0.001), and OASIS scores (40.709 ± 6.265 *vs.* 37.936 ± 8.043, P = 0.024). Importantly, patients in the abnormal base excess group exhibited higher in-hospital mortality compared to those with base excess between –3 and +3 mmol/L (26.6% *vs.* 7.6%, P < 0.001), as well as 30-day mortality (25.0% *vs.* 7.6%, P < 0.001), 90-day mortality (31.3% *vs.* 8.3%, P < 0.001), and 1-year mortality (32.8% *vs.* 12.9%, P < 0.001).

Relationship between the base excess level and the mortalities

We analyzed the relationship between the base excess and mortalities following aortic surgery using multivariate Cox regression. Compared to the referent group (base excess between –3 and +3 mmol/L), the HRs (95% CI) for in-hospital, 30-day, 90-day, 1-year mortality in the abnormal group were 4.413 (1.885–10.329), 2.894 (1.107–7.564), 3.605 (1.303–9.972), and 4.882 (1.569–15.191), respectively, in the unadjusted Cox

Table 2. Cox proportional hazards regression to assess the association between the base excess and in-hospital mortality, 30-day mortality, 90-day mortality, and 1-year mortality

Base excess	Model 1		Model 2		Model 3		Model 4	
	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value
In-hospital mortality								
Normal	1.000 (Reference)		1.000 (Reference)		1.000 (Reference)		1.000 (Reference)	
Abnormal	4.413 (1.885–10.329)	<0.001	2.894 (1.107–7.564)	0.030	3.605 (1.303–9.972)	0.014	4.882 (1.569–15.191)	0.006
30-Day mortality								
Normal	1.000 (Reference)		1.000 (Reference)		1.000 (Reference)		1.000 (Reference)	
Abnormal	4.067 (1.725–9.589)	0.001	2.712 (1.015–7.246)	0.047	3.274 (1.164–9.206)	0.025	4.541 (1.433–14.391)	0.010
90-Day mortality								
Normal	1.000 (Reference)		1.000 (Reference)		1.000 (Reference)		1.000 (Reference)	
Abnormal	5.000 (2.218–11.269)	<0.001	3.542 (1.444–8.690)	0.006	4.092 (1.606–10.426)	0.003	5.245 (1.882–14.615)	0.002
1-Year mortality								
Normal	1.000 (Reference)		1.000 (Reference)		1.000 (Reference)		1.000 (Reference)	
Abnormal	3.304 (1.593–6.849)	0.001	2.547 (1.119–5.799)	0.026	2.886 (1.229–6.774)	0.015	3.399 (1.366–8.462)	0.009

Model 1: crude. Model 2: adjusted for age, body mass index, gender, and ethnicity. Model 3: adjusted for heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, and SpO_2 in addition to variables in model 2. Model 4: adjusted for hypertension, heart surgery history, atrial fibrillation, coronary artery disease, Marfan syndrome, congestive heart failure, cerebrovascular disease, chronic obstructive pulmonary disease, and diabetes mellitus in addition to variables in model 3.
Normal, –3 to +3 mmol/L; abnormal, <–3 or >+3 mmol/L.
HR, hazard ratio; CI, confidence interval.

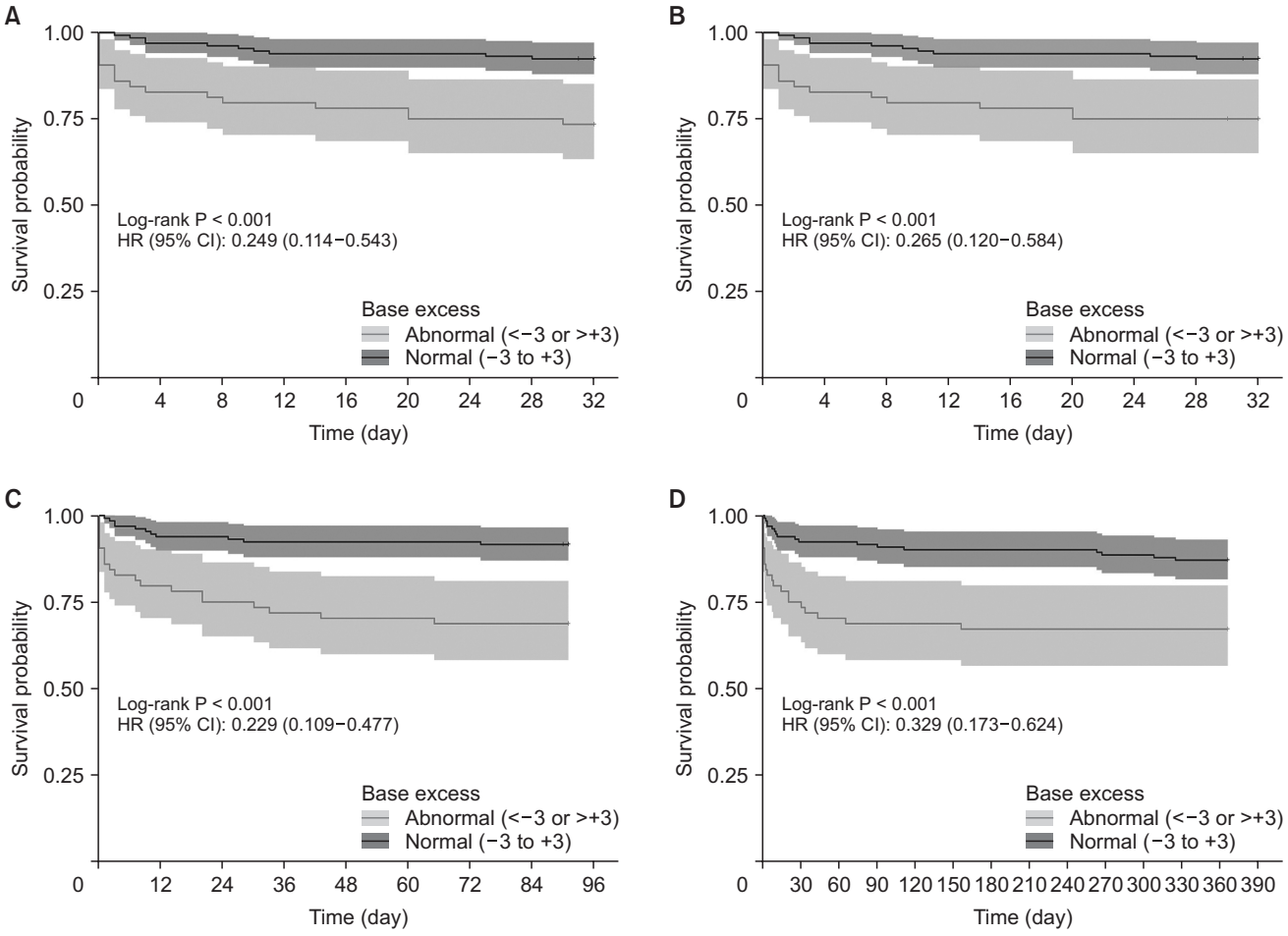

Fig. 2. Kaplan-Meier curves presenting the association between the base excess in blood gas and the in-hospital (A), 30-day (B), 90-day (C), and 1-year (D) mortalities after undergoing aortic surgery from MIMIC-IV (Medical Information Mart for Intensive Care IV) database. HR, hazard ratio; CI, confidence interval.

regression analysis of model 1 (Table 2). Model 2 indicated greater risks of mortalities in the abnormal base excess group by adjusting for age, BMI, gender, and ethnicity. Model 3 included the variables in model 1, along with heart rate, SBP, DBP, respiratory rate, and SpO_2. Model 4 was further adjusted for additional comorbidities, and abnormal base excess level remained significantly associated with mortalities.

The Kaplan-Meier survival curves for in-hospital, 30-day, 90-day, and 1-year mortality comparing the 2 groups are shown in Fig. 2. Patients with a base excess <−3 or >+3 mmol/L had significantly lower survival rates compared to those with normal base excess levels (log-rank test, $P < 0.001$ for all curves).

Subgroup analysis

Subgroup analysis was conducted based on age levels, BMI, SpO_2, mechanical ventilation time, vasopressin use, epinephrine use, and SOFA, adjusting for gender, age, ethnicity, BMI, heart rate, SBP, DBP, respiratory rate, and SpO_2 (Table 3). The results indicated no interaction across most strata (P for interaction = 0.056–0.988). The HRs for in-hospital mortality remained significant in the subgroups aged <70 years, BMI at different levels, SpO_2 ≥95%, mechanical ventilation time <90 hours, SOFA ≥7, and patients receiving epinephrine, as well as in those without vasopressin. The relationship between base excess and 30-day, 90-day, and 1-year mortality remained stable across the subgroups.

To assess the potential predictive role of base excess for mortalities and evaluate the predictive power of a model combining base excess and clinical scores, receiver operating characteristic curve analysis was performed. The area under the curve (AUC) for base excess as a continuous variable ranged from 0.699 to 0.745, while the AUC for base excess as a categorical variable ranged from 0.640 to 0.689. These results indicated similar performance to SAPSII and APSIII, and better performance than OASIS in all periods (Table 4). The AUC increased significantly when base excess was combined with the SOFA score.

Table 3. Association between the base excess group and in-hospital, 30-day, 90-day, and 1-year mortality of patients with aortic surgery in different subgroups

Variable	No. of patients	Mortality							
		In-hospital		30-day		90-day		1-year	
		HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value
Total	196 (100)	3.16 (1.30–7.66)	0.011	2.91 (1.18–7.19)	0.020	3.48 (1.54–7.85)	0.003	2.62 (1.27–5.40)	0.009
Age (yr)									
<70	129 (65.5)	5.09 (1.53–17.02)	0.008	5.02 (1.39–18.05)	0.014	6.62 (2.16–20.28)	<0.001	4.71 (1.77–12.53)	0.002
≥70	68 (34.5)	0.76 (0.12–5.01)	0.778	0.76 (0.12–5.01)	0.778	0.98 (0.19–5.07)	0.979	1.33 (0.35–5.12)	0.679
Body mass index (kg/m^2)									
<30	124 (68.5)	3.49 (1.02–11.91)	0.046	3.09 (0.88–10.84)	0.078	4.77 (1.64–13.91)	0.004	3.05 (1.25–7.40)	0.014
≥30	57 (31.5)	50.89 (2.36–1095.50)	0.012	50.89 (2.36–1095.50)	0.012	50.89 (2.36–1095.50)	0.012	50.89 (2.36–1095.50)	0.012
SpO_2 (%)									
<95	83 (43.2)	1.50 (0.10–21.84)	0.766	1.50 (0.10–21.84)	0.766	4.70 (0.68–32.70)	0.118	2.92 (0.56–15.18)	0.204
≥95	109 (56.8)	4.09 (1.34–12.50)	0.014	3.76 (1.21–11.71)	0.022	3.92 (1.37–11.20)	0.011	2.78 (1.13–6.87)	0.027
Mechanical ventilation time (hr)									
<90	148 (75.1)	5.27 (1.63–17.06)	0.006	5.27 (1.63–17.06)	0.006	5.02 (1.70–14.87)	0.004	3.36 (1.28–8.85)	0.014
≥90	49 (24.9)	13.50 (0.92–197.63)	0.057	14.09 (1.12–177.16)	0.041	8.36 (0.97–71.92)	0.053	2.59 (0.61–10.96)	0.195
Vasopressin use									
No	147 (74.6)	4.80 (1.03–22.31)	0.046	1.19 (0.00–Inf)	1.000	1.19 (0.00–Inf)	1.000	1.19 (0.00–Inf)	1.000
Yes	50 (25.4)	3.25 (0.60–17.42)	0.170	4.08 (1.53–10.90)	0.005	4.28 (1.81–10.16)	<0.001	2.99 (1.41–6.36)	0.004
Epinephrine use									
No	108 (54.8)	1.36 (0.09–20.54)	0.825	1.36 (0.09–20.54)	0.825	1.36 (0.09–20.54)	0.825	4.02 (0.27–58.89)	0.310
Yes	89 (45.2)	5.06 (1.48–17.30)	0.010	4.75 (1.34–16.78)	0.016	4.50 (1.60–12.67)	0.004	3.17 (1.30–7.75)	0.011
SOFA									
<7	34 (18.8)	1.19 (0.00–Inf)	1.000	4.80 (1.03–22.31)	0.046	5.73 (1.53–21.50)	0.010	4.10 (1.39–12.11)	0.011
≥7	147 (81.2)	4.49 (1.71–11.82)	0.002	3.23 (0.59–17.69)	0.176	4.42 (0.86–22.69)	0.075	2.61 (0.62–10.96)	0.189

Reference group: patients in the normal base excess group.
Adjusted variables included gender, age, ethnicity, body mass index, heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, and SpO_2.
HR, hazard ratio; CI, confidence interval; SOFA, Sequential Organ Failure Assessment.

Table 4. Area under receiver operating characteristic curve (AUC) of the base excess and severity scores

Variable	AUC (95% CI)			
	In-hospital	30-Day	90-Day	1-Year
Base excess[a)]	0.718 (0.607–0.830)	0.707 (0.593–0.821)	0.745 (0.644–0.846)	0.699 (0.602–0.796)
Base excess[b)]	0.676 (0.577–0.775)	0.667 (0.565–0.768)	0.689 (0.597–0.781)	0.640 (0.553–0.728)
SOFA	0.780 (0.675–0.885)	0.768 (0.659–0.876)	0.775 (0.679–0.871)	0.722 (0.627–0.817)
APSIII	0.681 (0.577–0.784)	0.737 (0.643–0.831)	0.760 (0.674–0.846)	0.711 (0.620–0.802)
SAPSII	0.752 (0.660–0.844)	0.690 (0.584–0.796)	0.632 (0.530–0.734)	0.615 (0.518–0.712)
OASIS	0.662 (0.535–0.789)	0.644 (0.515–0.773)	0.674 (0.561–0.788)	0.654 (0.552–0.757)
SOFA+ base excess[a)]	0.799 (0.693–0.906)	0.784 (0.673–0.895)	0.817 (0.719–0.915)	0.761 (0.667–0.856)
SOFA+ base excess[b)]	0.811 (0.710–0.912)	0.768 (0.659–0.876)	0.812 (0.719–0.905)	0.750 (0.654–0.846)

CI, confidence interval; SOFA, Sequential Organ Failure Assessment; APSIII, Acute Physiology Score III; SAPSII, Simplified Acute Physiology Score II; OASIS, Oxford acute severity of illness score.
[a)]Continuous variable. [b)]Categorical variable.

DISCUSSION

In this single-center cohort study, we observed that admission base excess beyond the reference range (<–3 or >+3 mmol/L) predicted in-hospital, 30-day, 90-day, and 1-year mortality in postoperative patients with aortic dissection. This association remained significant even after adjusting for age, BMI, gender, ethnicity, vital signs, and comorbidities. The predictive power of postoperative scoring systems could be enhanced by incorporating base excess levels. Therefore, admission base excess may serve as a useful predictor of mortality following open surgical repair for aortic dissection.

Aortic dissection is a life-threatening condition characterized by rapid onset, rapid progression, and high mortality. Prompt surgical intervention is necessary due to an alarmingly high mortality rate among untreated patients. Within the first 6 hours of onset, the mortality rate is 22.7%, which increases to 33.3% within 12 hours, 50% within 24 hours, and a devastating 68.2% within the first 2 days after admission [6]. Therefore, the identification of simple biomarkers for prognosis evaluation is crucial for effective risk stratification. Previous studies have highlighted various factors, such as admission heart rate, bicarbonate, lymphocyte to monocyte ratio, CRP, serum amyloid A protein, and hypotensive SBP, as independently prognostic factors in acute aortic dissection [12-18]. However, the association with postoperative mortality was not evaluated. Currently, effective biomarkers to predict postoperative outcomes in aortic dissection remain lacking. Our study, however, revealed the potential value of base excess at admission in predicting operative mortality in aortic dissection.

Base excess refers to an excess of base in the blood, representing the metabolic component of acid-base balance, distinct from the respiratory component (carbon dioxide). Base excess can help identify various metabolic disturbances. The use of CPB during cardiac surgery may exacerbate acid-base imbalances, with postoperative metabolic changes often best reflected by lactate levels and base excess. Severely reduced base excess (≤–6.7) has been found to be a more reliable predictor of ICU mortality than hyperlactatemia in cardiac surgery patients [19]. Bicarbonate, the predominant base in base excess, has been shown to predict short-term and long-term mortalities in acute aortic dissection patients after ICU admission [13]. However, base excess is a more comprehensive measurement, encompassing all metabolic acid-base balance. In different clinical contexts, base excess levels reflect distinct metabolic disorders. In acute heart failure patients, high base excess (>2), but not low base excess, on admission has been associated with higher long-term mortality [20]. Severe acidosis (base excess ≤–10) is a strong risk factor for operative mortality [10,21]. When combining abdominal malperfusion, no patient with severe acidosis survived in this circumstance [8]. A multicentered, real-world cohort of type A aortic dissection patients in China used a machine learning algorithm (XGBoost) to develop a risk model predicting 30-day postoperative mortality, where base excess was identified as one of the top predictors [22]. To date, few studies have explored the relationship between base excess and clinical outcomes beyond 30-day mortality in aortic surgery nor have they compared its predictive value to existing scoring systems. Our study demonstrated that base excess levels beyond the reference range correlated with longer mechanical ventilation time and higher mortalities across all periods, particularly during hospitalization and within 30 days. Besides, the predictive value of base excess showed similar performance to SAPSII and APSIII, and outperformed OASIS, enhancing the predictive power of SOFA score by incorporating it. Subgroup analyses confirmed the robustness of these findings.

However, this retrospective study is subject to certain limitations. Due to its retrospective design, selection bias may be present, and the cohort size was relatively small. The MIMIC-IV database may have incomplete data on confounding factors, such as bilirubin levels, serum lipid levels, durations of the operations, aortic clamping, and CPB, which were not analyzed

in this study. Additionally, information on the severity and types of aortic dissection was not available in the database. Future high-quality prospective studies are necessary to validate these findings.

In conclusion, our findings indicate that abnormal base excess values upon admission are associated with higher mortality rates after open-chest chest surgery for aortic dissection. As a simple and cost-effective laboratory test, base excess could serve as a predictor for poor prognosis, aiding in preoperative screening and guiding early, aggressive intervention for better patient management.

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Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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