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ORIGINAL RESEARCH

Delayed Diagnosis and Outcomes in Acute Aortic Dissection: A 10-Year Single-Center Retrospective Study

Suluck Kanoksirirat, Adisak Nithimathachoke

Department of Emergency Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand

Correspondence: Adisak Nithimathachoke, Department of Emergency Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, 681 M Floor, Petcharatch Building, Samsane Road, Wachiraphayaban, Dusit, Bangkok, Thailand, 10300, Tel +66-2-244-3189, Email adisak@nmu.ac.th

Introduction: Acute aortic dissection is a rare and life-threatening condition with highly variable clinical presentations, often resulting in atypical symptoms and initial misdiagnosis. This study aimed to investigate clinical presentations and explore the associations between clinical characteristics, delayed diagnosis, and in-hospital mortality among patients with acute aortic dissection.

Methods: A retrospective chart review was performed on patients presenting with acute aortic dissection at an urban academic emergency department in Thailand between January 1, 2011, and December 31, 2020. Baseline characteristics, clinical presentations, imaging findings, delayed diagnosis (>4 h from first emergency department contact), and in-hospital mortality rates were analyzed.

Results: The study included 103 patient charts, predominately men (71 patients), with a median age of 71 years (interquartile range of 58–78 years). Abdominal pain (36.9%) and thoracic pain (24.3%) were the most common presenting symptoms. Dyspnea (11.7%), altered consciousness (4.9%), and syncope (4.9%) were the three main painless presenting atypical symptoms. Atypical presentations were not significantly associated with delayed diagnosis, which occurred in 27.2% of cases. Normotension, a history of coronary artery disease, and pleural effusion were associated with delayed diagnosis. Abnormal chest films were major risk factors for in-hospital mortality, observed in 22.3% of patients with acute aortic dissection, whereas delayed diagnosis was not directly related to such mortality.

Conclusion: The incidence of acute aortic dissection in the urban Thai population was 32.4 per 100,000 patient-years, with a range of clinical presentations. A high index of suspicion for AAD is crucial for timely diagnosis, even in patients with atypical symptoms and seemingly normal vital signs. Careful interpretation of chest radiographs is essential as abnormal chest X-ray findings are associated with a poorer prognosis.

Keywords: aortic dissection, delayed diagnosis, atypical presentation, mortality, incidence

Introduction

Acute aortic dissection (AAD) is a rare and life-threatening condition that remains challenging to diagnose and treat. The common presentation of AAD includes sudden, severe chest and back pain.[1–3] However, AAD's clinical manifestations vary widely and overlap with more common conditions. Patients often present atypically, with symptoms including abdominal pain, neck pain, or even no pain.[1,3–5] These atypical characteristics lead to a 14–78% rate of delayed diagnosis or misdiagnosis.[1,6] Previous studies have revealed high mortality rates in patients with AAD due to atypical presentations.[1,2,4,7] Moreover, untreated AAD can increase mortality by 1–2% h^{-1} within the first 48 h after symptom onset.[8,9]

Several studies across different populations, including Asia, have focused on the characteristics, investigation, management, and outcomes of AAD.[1,10–12] However, few studies have addressed this topic in Thailand. Those that have been published were conducted in suburban areas and included only six patients with AAD in one study.[13,14] Therefore, we performed a hospital-based cohort study to identify the typical and atypical presentations and initial

Received: 14 September 2024
Accepted: 23 April 2025
Published: 9 May 2025

imaging in AAD. We also investigated the association between clinical characteristics and (i) delayed diagnosis and (ii) in-hospital mortality.

Methods

Study Design

This descriptive retrospective study was conducted at an urban tertiary emergency department (ED) in Thailand between January 1, 2011, and December 31, 2020. The study was approved by the Vajira Institutional Review Board (VIRB), Faculty of Medicine Vajira Hospital (COA 145/2565). Given the study's retrospective nature and use of de-identified medical records, the IRB waived the requirement for written informed consent. Patient confidentiality was strictly maintained through anonymization, and all data handling complied with the ethical principles outlined in the Declaration of Helsinki.

Study Population

This study enrolled patients who presented to the ED between January 1, 2011, and December 31, 2020, and had AAD confirmation.

Data Collection

Data were extracted from the hospital's electronic database for patients diagnosed with specific ICD10 (I71.xx) who underwent computed tomographic angiography (CTA) as the gold standard for diagnosing AAD between January 1, 2011, and December 31, 2020. Patients with known aortic dissection, those referred from other hospitals, and those with incomplete data were excluded. Collected data included sex, age, comorbidities, chief complaint, pain severity and location, imaging results [chest X-ray (CXR), ultrasonography, and computed tomography], Stanford classifications, in-hospital mortality, and time to diagnosis.

Pain severity was assessed using a numerical pain scale in the ED. Radiologists interpreted all CTA results, whereas CXR and ultrasonography results were obtained from physicians' reports. Time to diagnosis was defined as the duration from patient arrival at the ED to AAD diagnosis by the attending physician.

Outcomes

The primary outcome comprised the characteristics of aortic dissection, including the distribution of presenting symptoms, in-hospital mortality rate, and frequency of delayed diagnoses among patients with AAD. Secondary outcomes included associations between patients' clinical characteristics and (i) delayed diagnosis and (ii) in-hospital mortality.

Definitions

Atypical presentation: Patients with AAD presenting with pain solely in locations such as the abdomen, neck, or legs, or those without pain, were categorized as having atypical presentations. Traditional AAD symptoms included sudden, severe chest or back pain and hypertension.[15]

Delayed diagnosis: In the absence of a consensus definition, we defined delayed AAD diagnosis based on previous studies. Higginson et al[16] suggested a 4-h timeframe as a performance indicator for emergency departments, with potential adverse outcomes due to ED overcrowding. An aortic dissection registry reported a median AAD diagnosis time of 4.3 h [interquartile range (IQR) 1–3: 1.5–24.0 h],[1] with significantly reduced survival rates observed beyond 24 h from symptom onset.[17] Another study indicated higher mortality rates in patients with AAD undergoing surgery >4 h after diagnosis, escalating further after 8 h.[18] Hence, we adopted a 4-h cutoff period for delayed diagnosis.

In-hospital mortality: Death occurring during hospitalization due to AAD.

Aortic dissection classification: Aortic dissections were classified according to the Stanford classification as Group A dissections, where the origin of tearing was anywhere along the ascending aorta, and Group B dissections, which did not involve the ascending aorta.

Statistical Analysis

All analyses were performed using R version 4.2.1. Descriptive statistics were presented as means ± standard deviations or medians ± IQRs. Normality was assessed using the Shapiro–Wilk test at a significance level of 0.05. Mean or proportion comparisons were performed using Student's *t*-test or the Wilcoxon rank-sum test. Categorical data were presented as numbers and percentages and compared using Pearson's chi-squared test or Fisher's exact test. Multivariable logistic regression was employed to identify independent factors associated with (i) time to diagnosis and (ii) in-hospital mortality, including variables with p-value < 0.10. Odds ratios (ORs) with 95% confidence intervals (CIs) were estimated after adjustment for multiple factors, with a stepwise strategy employed to retain variables with p-value ≤ 0.15. A backward strategy was used to verify the final model. All tests were two-sided and considered statistically significant at p-value ≤ 0.05.

Results

Between January 1, 2011, and December 31, 2020, 178 patients were assessed for eligibility, with 103 (58.5%) of these enrolled in the study. Patients were excluded for the following reasons: i) known AAD cases (n = 16), ii) incomplete data (n = 43), and iii) referral to our institute for definitive surgery (n = 16) (Figure 1).

Of the 103 enrolled patients, 39 and 64 had AAD type A and type B, respectively. All patients with type A AAD underwent surgery, except two who experienced cardiac arrest prior to operation. Treatment modalities for patients with type B AAD varied and are not listed in this study. With 103 enrolled patients, the post-hoc power was 67.7 (alpha 0.05). Demographic data, presenting symptoms, physical examinations, and imaging findings are detailed in the subsequent sections.

Demographic Data

The median age (IQR) was 71 (58–78), with men comprising 68.9% of the cohort. Although the majority of patients were elderly, those with type B AAD tended to be older than those with type A (p-value = 0.04). Hypertension was the most prevalent underlying disease (66%), with no significant difference between types of aortic dissection (p-value = 1). Other comorbidities occurred in <25% of patients. Few patients exhibited high-risk features, such as aortic valve disease (5 cases; 4.9%) or Marfan syndrome (2 cases; 1.9%). Additional demographic data are presented in Table 1.

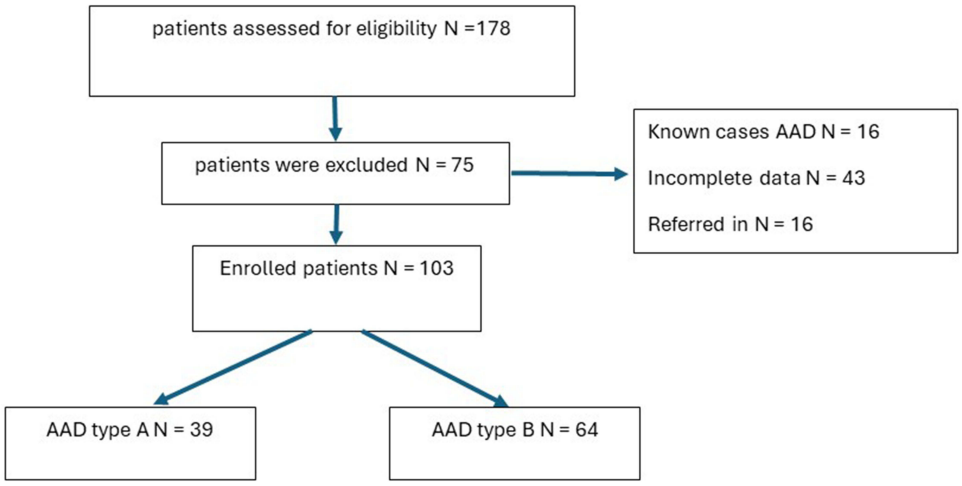

Figure 1 Inclusion and Exclusion flow chart.

https://doi.org/10.2147/OAEM.S496279

Table 1 Demographic Data Compare with Type of AAD

Variable	Type A (N=39)	Type B (N=64)	Total (N=103)	*P* value
Age (IQR)	64 (51.5,75)	72.5 (62.8)	71 (58,78)	0.004
Male (%)	26 (66.7)	45 (70.3)	71 (68.9)	0.866
Underlying disease	31 (79.5)	50 (78.1)	81 (78.6)	1.00
Hypertension (%)	26 (66.7)	42 (65.6)	68 (66)	1.00
Dyslipidemia (%)	7 (17.9)	17 (26.6)	24 (23.3)	0.446
Coronary artery disease (%)	4 (10.3)	15 (23.4)	19 (18.4)	0.158
Chronic kidney disease	1 (2.6)	8 (12.5)	9 (8.7)	0.148
Cerebrovascular disease (%)	3 (7.7)	4 (6.2)	7 (6.8)	1.00
Diabetes Mellitus (%)	2 (5.1)	5 (7.8)	7 (6.8)	0.707
Dysrhythmia (%)	3 (7.7)	2 (3.1)	5 (4.9)	0.364
Aortic valve disease (%)	2 (5.1)	3 (4.7)	5 (4.9)	1.00
Aortic aneurysm (%)	1 (2.6)	4 (6.2)	5 (4.9)	0.647
Marfan's syndrome (%)	2 (5.1)	0 (0)	2 (1.9)	0.141
Cirrhosis (%)	0 (0)	1 (1.6)	1 (1)	1.00

Primary Outcome

Pain was the chief complaint in most patients with AAD (71.8%), with chest pain (43.6%) and abdominal pain (50%) being the most common chief complaints in types A and B, respectively. However, pain characteristics were not consistently documented in most medical records. The three most common painless presenting symptoms were dyspnea (11.7%), altered consciousness (4.9%), and syncope (4.9%).

There was no statistically significant difference in pain severity between the two AAD groups. However, Patients with type A AAD tended to present earlier to the ED compared to those with type B AAD (2 vs 17 h; p-value = 0.011; Table 2). Initial blood pressures were primarily in the normotensive to hypertensive range, with no significant differences in blood pressure and heart rate between AAD types. Chest and back pain were reported by 32.0% (n = 33) of patients

Table 2 Presentation, Physical Examination, and Imaging of Patients in Type A and Type B AAD

Variable	Type A (N=39)	Type B (N=64)	Total (N=103)	*P* value
Chief complaint				< 0.001
Abdominal pain (%)	6 (15.4)	32 (50.0)	38 (36.9)	
Chest pain (%)	17 (43.6)	8 (12.5)	25 (24.3)	
Dyspnea (%)	4 (10.3)	8 (12.5)	12 (11.7)	
Back pain (%)	4 (10.3)	4 (6.2)	8 (7.8)	
Alteration of Conscious (%)	3 (7.7)	2 (3.1)	5 (4.9)	
Syncope (%)	2 (5.2)	3 (4.7)	5 (4.9)	
Neck pain (%)	1 (2.6)	1 (1.6)	2 (1.9)	

(*Continued*)

Table 2 (Continued).

Variable	Type A (N=39)	Type B (N=64)	Total (N=103)	*P* value
Seizure (%)	0 (0)	2 (3.1)	2 (1.9)	
Fatigue (%)	1 (2.6)	1 (1.6)	2 (1.9)	
Flank pain (%)	0 (0)	1 (1.6)	1 (1)	
UGIB (%)	1 (2.6)	0 (0)	1 (1)	
LGIB (%)	0 (0)	1 (1.6)	1 (1)	
Vomiting (%)	0 (0)	1 (1.6)	1 (1)	
Onset (Hour)	2 (1,16.5)	17 (2,72)	7 (1.5,48)	0.011
Painful (%)	28 (71.8)	46 (71.9)	74 (71.8)	0.993
Pain score (IQR)	8 (2.5,9.5)	7 (1,10)	7 (1,10)	0.403
Recent aortic manipulation (%)	1 (2.6)	2 (3.1)	3 (2.9)	1.00
High risk condition (%)	15 (38.5)	33 (51.6)	48 (46.6)	0.276
Systolic blood pressure (SD)	143.5 (46)	144.7 (39.4)	144.3 (41.8)	0.894
Diastolic blood pressure (SD)	80.6 (24.4)	84.2 (20.4)	82.9 (21.9)	0.427
Heart rate (SD)	77.9 (19.2)	81.3 (18.5)	80 (18.7)	0.386
Physical Examination				
Blood pressure differentiation (%)	19 (48.7)	13 (20.3)	32 (31.1)	0.003
Murmur (%)	6 (15.3)	2 (3.1)	8 (7.8)	0.020
Delayed pulse (%)	2 (5.1)	5 (7.8)	7 (6.8)	0.600
Lateralizing sign (%)	2 (5.1)	1 (1.6)	3 (2.9)	0.290
Chest film			102 (99.0)	
Abnormal chest film (%)	32 (82)	33 (51.6)	65 (63.1)	0.002
Widening mediastinum (%)	29 (74.3)	31 (48.4)	60 (58.3)	0.009
Pleural effusion (%)	9 (23.1)	2 (3.2)	11 (10.7)	0.001
Abnormal aortic contour (%)	3 (7.7)	1 (1.6)	4 (3.9)	0.110
Trachea shifting (%)	1 (1.6)	0 (0)	1 (0.97)	1.00
Ultrasonography			73 (70.9)	
Abnormal ultrasound (%)	31 (79.5)	25 (39.1)	56 (54.4)	< 0.001
Aortic flap (%)	5 (12.8)	37 (57.8)	42 (40.8)	< 0.001
Dilated aortic root (%)	20 (51.3)	9 (14.1)	29 (28.2)	< 0.001

with AAD, whereas 67.9% of patients (n = 70) presented with atypical symptoms, including abdominal pain. Neurological symptoms were observed in both AAD types, except for seizures, which were reported only in type B cases (Figure 2).

Physical examination abnormalities were more common in type A AAD (74.4%) than in type B (32.8%), with differences in blood pressure in all extremities (p = 0.003) and the presence of heart murmurs (p-value = 0.02)

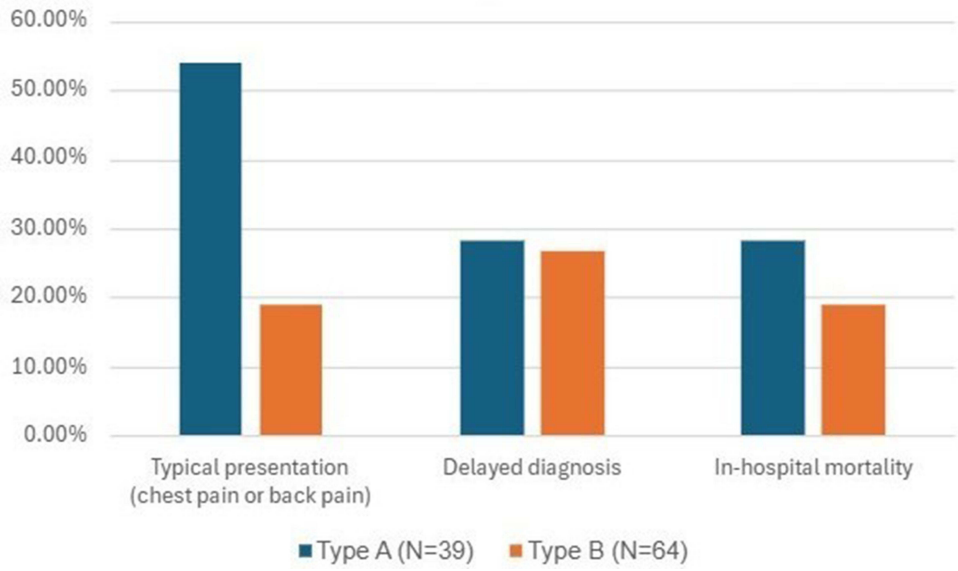

Figure 2 Percentage of typical presentation, delayed diagnosis, and in-hospital mortality in type A and type B AAD.

significantly associated with type A AAD. Initial imaging studies, including CXR and bedside ultrasonography, were conducted in 102 patients and 73 patients, respectively. All patients underwent CTA, with results reported by radiologists. Abnormal findings on CXR and ultrasound are detailed in Table 2. Notably, mediastinal widening was observed in 74.3% and 48.4% of type A and type B AAD cases, respectively (p-value = 0.009). An aortic flap was significantly more prevalent in type B AAD cases, accounting for 57.8% (p-value < 0.001), whereas a dilated aortic root was characteristic in 51.3% of type A AAD cases (p-value < 0.001).

Secondary Outcomes

In total, 28 patients (27.2%) experienced delayed diagnosis (>4 h), with similar proportions observed in type A and type B AAD (28.2% vs 26.5%). In-hospital mortality occurred in 23 patients (22.3%) and was evenly distributed between type A and type B AAD (Table 3). Atypical presentation and in-hospital mortality did not show statistically significant associations with delayed diagnosis (Table 4).

Delayed Diagnosis

In the following results, patients with delayed diagnosis were compared to those without delayed diagnosis. The former group exhibited significantly higher systolic blood pressure (164.7 vs 136.6 mmHg; p-value = 0.002) and diastolic blood pressure (95.5 vs 78.1 mmHg; p-value < 0.001). They also tended to be older with a higher prevalence of at least one underlying disease and longer durations from symptom onset to ED arrival. Painless presentations were more frequent

Table 3 Type of AAD and 1) Delayed Diagnosis 2) In-Hospital Mortality

Variable	Type A (N = 39)	Type B (N = 64)	Total (N = 103)
Delayed diagnosis (%)	11 (28.2)	17 (26.6)	28 (27.2)
In-hospital mortality (%)	11 (28.2)	12 (18.8)	23 (22.3)

Table 4 Comparison Between Delayed Diagnosis and I) Atypical Presentation II) In-Hospital Mortality

Delayed diagnosis			
Atypical presentation	**Yes**	**No**	**P value 0.059**
Yes	5 (15.2)	28 (84.8)	
No	23 (32.8)	47 (67.2)	
In-hospital mortality			P value 0.232
Yes	9 (39.1)	14 (60.9)	
No	19 (23.75)	61 (76.25)	

among patients with delayed AAD diagnosis (35.7% vs 25.4%; p-value = 0.347). Patients in the delayed diagnosis group showed lower rates of abnormal physical examination and ultrasonography as well as higher rates of abnormal CXR.

However, except for systolic and diastolic blood pressures, these characteristics did not show statistically significant associations with delayed diagnosis (Supplementary Tables 1a, 1b, and 2).

In-Hospital Mortality

In-hospital mortality occurred in 11 and 12 cases of type A and B AAD, respectively. Significant predictors of in-hospital mortality included higher heart rate (77 vs 91 beats per minute; p-value = 0.001) and the presence of pleural effusion on CXR (6.2% vs 26.1%; p-value = 0.014). Patients in the mortality group tended to be younger compared with those in the survival group and had higher median pain scores (9 vs 7; p-value = 0.104) and earlier presentation to the ED (3 vs 9 h; p-value = 0.088). Additionally, patients in the mortality group exhibited more frequent abnormal findings on physical examination, CXR, and ultrasonography compared with surviving patients. Among these, only higher heart rate (77 vs 91 beats per minute; p-value = 0.001) and the presence of pleural effusion on CXR (6.2% vs 26.1%; p-value = 0.014) were significantly associated with in-hospital mortality (Supplementary Tables 3–5).

After selecting variables with p-value < 0.10 potentially associated with outcomes of interest, regression analysis revealed that in addition to systolic blood pressure, a history of coronary artery disease (CAD; OR: 3.08; CI: 1.39–8.67) and pleural effusion on CXR (OR: 3.82; CI: 1.06–13.73) were significantly associated with delayed diagnosis (Table 5). Additionally, patients with mediastinal widening (OR: 3.17; CI: 1.07–9.38) or pleural effusion (OR: 5.29; CI: 1.45–19.39) on CXR had a higher likelihood of in-hospital mortality (Table 6).

Table 5 Multivariable Analysis of Delayed Diagnosis by Logistic Regression

Parameter		Odd ratio	95% CI	P value
Atypical presentation	Yes vs No	2.74	(0.94,8.02)	0.066
Coronary artery disease	Yes vs No	3.08	(1.39,8.67)	0.033
Chronic kidney disease	Yes vs No	3.86	(0.96,15.59)	0.058
Cerebrovascular disease	Yes vs No	4.00	(0.84,19.16)	0.083
SBP ≥ 100 mmHg	Yes vs No	3.85	(1.24,12.56)	0.029
Pleural effusion	Yes vs No	3.82	(1.06,13.73)	0.040

Table 6 Multivariable Analysis of in-Hospital Mortality by Logistic Regression

Parameter		Odd ratio	95% CI	P value
Atypical Presentation	Yes vs No	1.44	(0.51,4.08)	0.489
Coronary artery disease	Yes vs No	0.16	(0.02,1.25)	0.079
Abnormal chest film	Yes vs No	3.41	(1.06,10.95)	0.025
Widening mediastinum	Yes vs No	3.17	(1.07,9.38)	0.026
Pleural effusion	Yes vs No	5.29	(1.45,19.39)	0.013

Discussion

The incidence of AAD in this study was 32.4 per 100,000 patient-years, based on 50,000 ED visits annually at the study site. This rate exceeds those reported in previous studies on aortic dissection, which ranged from 3 to 16 per 100,000 individuals per year.[3,9,10,15,19] While this discrepancy cannot be fully explained, older age (mean age, 71 years old) may be a contributing factor. A Japan-based population study, with age-adjusted analysis, demonstrated this possibility, reporting an incidence of 17.6 per 100,000 patient-years.[10] Moreover, the previous incidence of AAD might be underestimated due to factors such as misdiagnosis and patients dying undiagnosed.[15] Furthermore, the prevalence of aortic dissection among the ED population during the studied decade was 0.04%, highlighting its rarity compared with more prevalent emergency conditions, such as acute myocardial infarction.[20,21]

Atypical presentations constituted > 50% of the AAD cases in this study. Varied presentations, normal vital signs, and inconspicuous findings in physical examinations pose challenges for emergency physicians diagnosing AAD. Thus, the high rate of atypical presentations has implications for clinical practice, particularly regarding early detection, emphasizing the importance of heightened AAD awareness. Most patients in the study were elderly and predominantly men, consistent with findings from previous studies.[1,3,14,22] Elevated blood pressure is a known risk factor for AAD development and potentially contributes to increased mortality rates.[1,23] Hypertension was present in 66% of patients in our study, with no significant difference observed between type A and type B AAD. In contrast to prior research, 76% of patients with AAD had a history of hypertension, which was more prevalent in type B AAD cases.[1,12] The overlap of symptoms with acute coronary syndrome may also delay AAD diagnosis, leading to inappropriate administration of antiplatelet therapies.[5,7,24]

Pain is the predominant symptom in patients with AAD but varies in its location. Abdominal pain (36.9%) and chest pain (24.3%) were the predominant presentations, being observed at significant frequencies in type B and type A AAD cases, respectively. This distribution is comparable with other studies,[12,14,25] although abdominal pain as a primary presentation was reported in only 4.6% of AAD cases in a broader population analysis conducted from 1996 to 2001.[4] Increased awareness of abdominal pain as a sole symptom of AAD and advances in imaging may account for this discrepancy. Notably, the association between pain sites and Stanford type in AAD exhibits heterogeneity across studies.[1,4,12,14,22,25]

Atypical presentations prompted ED visits in most patients (67.9%) and were significantly correlated with AAD type, particularly driven by abdominal pain and dyspnea. Considering a risk scoring system emphasizing AAD as a possible cause in cases of abdominal pain,[9] atypical presentations in our study were markedly reduced to 31.1%, although this rate remains higher than previously reported.[12] Painless presentations were observed in 28.2% of patients, exceeding rates of 4–22% reported in earlier studies[1,6,12,24] Larger sample sizes and more sophisticated analyses, potentially including additional variables, are needed to further investigate the relationships between atypical presentation, in-hospital mortality, and delayed diagnosis. Unlike findings from a Taiwanese study,[12] which suggested that atypical presentations might be associated with a higher likelihood of delayed diagnosis, this finding did not reach statistical significance in our cohort. The discrepancy may be due to differences in the definitions of atypical presentations. However, both studies found no association between atypical presentation and in-hospital mortality.

Imaging studies play a critical role in AAD diagnosis. Approximately 37% of patients had normal initial CXRs, comparable with >20–30% reported previously.[1,3,22] Abnormal CXR findings were significantly more prevalent in type A AAD cases, especially mediastinal widening, the most common abnormality observed, aligning with prior studies[1,3,12,22] Ultrasonography is considered highly beneficial for detecting AAD,[9] with abnormalities reported in around 75% of our patients compared with 62–64% in a previous study.[22] In type A AAD cases, a dilated aortic root was a common feature on ultrasound, whereas patients with type B AAD often exhibited an intra-aortic flap.

In our study, 25% of AAD cases were diagnosed in >4 h, a rate consistent with prior studies,[5,6,11,12] although definitions vary across studies. Atypical presentations/features, normotension (systolic blood pressure ≥105 mmHg), and normal physical examination were identified as significant risk factors.[6,7,12] However, in a study of 189 type A AAD cases, these factors did not differ between early and delayed diagnosis groups.[5] In the current study, normal blood pressure, CAD, and pleural effusion, rather than atypical presentation, emerged as risk factors for delayed diagnosis. Factors affecting timely AAD diagnosis, such as physician experience, imaging availability, and ED crowding during initial visits, warrant further investigation as potential contributors to delayed AAD diagnosis. We found that the in-hospital mortality rate in the delayed diagnosis group differed from that in the control group but did not reach statistical significance, consistent with previous studies.[5,6,12]

The in-hospital mortality rates in this study were relatively low compared with previous studies (22.3% vs 31–45%),[5,6,11,12,24,26] particularly in type A AAD cases. Advances in surgical techniques and increased surgical intervention rates may have contributed to this decline.[1,9] However, patients with type B AAD and concurrent abdominal pain experienced significantly higher mortality rates compared to those without abdominal pain.[1,4,9] Pain severity in the in-hospital mortality group led to earlier ED visits, although normal blood pressure (both systolic and diastolic) associated with delayed diagnosis did not correlate with in-hospital mortality. Widening mediastinum and pleural effusion were significantly more common in the mortality group, likely reflecting their association with type A AAD, hypotension, and increased in-hospital mortality risk. Based on previous studies, comorbidities, and initial vital signs exert a greater influence on in-hospital mortality compared with variations in standard treatment protocols.[1,3,17] Further studies on diagnosis-to-operation times, surgical approaches in type A AAD cases, and treatment modalities in type B AAD cases are required to deepen our understanding of in-hospital mortality determinants.

Abnormal findings on CXRs, specifically widening mediastinum and pleural effusion, were the only factors significantly associated with in-hospital mortality based on multivariable analysis. However, pleural effusion, although indicative of delayed diagnosis, was not correlated with in-hospital mortality.[1] Furthermore, abnormal CXRs were not associated with mortality rates in a previous study.[12] Despite prior research indicating significantly higher mortality rates among patients with type B AAD and concurrent abdominal pain compared to those without abdominal pain,[4,9] no significant association was observed between abdominal pain and mortality in the present study. Similarly, although the in-hospital mortality group exhibited higher median pain scores, no clear relationship between pain and mortality was found. Normal blood pressure (both systolic and diastolic) was associated with delayed diagnosis, although it did not influence in-hospital mortality.

Limitations

This retrospective chart review has several limitations, including potential data inaccuracies and potential selection biases. Furthermore, the study's single-center nature in Thailand may limit the results' generalizability to other populations. The limited sample size and parameters may have resulted in insufficient power to detect significant associations between outcomes. Moreover, patients with undiagnosed AAD or those diagnosed only after admission were excluded owing to the missing data, potentially affecting study findings. Finally, the appropriateness of the 4-h cutoff for delayed diagnosis is subject to debate.

Conclusion

In our study, the incidence of AAD was 32 per 100,000 patient-years, particularly among elderly men with underlying hypertension. Atypical presentations of AAD were observed in approximately 68% of the cases, emphasizing the importance of a high index of suspicion for AAD in patients presenting with atypical symptoms, such as unexplained

abdominal discomfort, dyspnea, or syncope, and even in the absence of vital sign abnormalities. While this study did not establish a conclusive link between atypical presentation and delayed diagnosis, it warrants further investigation. Identifying an optimal cutoff time for defining delayed diagnosis could provide valuable insights into improving patient outcomes. Future research should focus on larger cohorts and explore the impacts of factors such as physician's level of experience, institutional diagnostic protocols, and access to advanced imaging on the timeliness of AAD diagnosis.

Abbreviations

AAD, acute aortic dissection; BP, blood pressure; CI (95% CI), 95% confidence intervals; CTA, computed tomographic angiography; CXR, chest film, chest radiography; DBP, diastolic blood pressure; ED, emergency department; IQR, interquartile range; OR, odds ratio; SBP, systolic blood pressure.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author, AN, upon reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the Vajira Institutional Review Board (VIRB), Faculty of Medicine Vajira Hospital Ethics Committee (COA 145/2565), and conducted in accordance with the Good Clinical Practice (GCP) Guidelines and the Declaration of Helsinki. As the study involved the retrospective analysis of anonymized records, the IRB waived the requirement for written informed consent. To ensure patient confidentiality, all data were de-identified before analysis, access was restricted to authorized researchers, and strict data security measures were enforced to prevent unauthorized use. The study adhered to institutional and international ethical standards.

Consent for Publication

All patient data used in this study were anonymized and analyzed in compliance with institutional review board regulations.

Acknowledgment

The authors are grateful for the valuable suggestions and comments provided by all the faculty members. We also extend our heartfelt thanks to the staff at the emergency department for their support during the study.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This study was sponsored by Navamindradhiraj University Research Fund. The funding body was not involved in any part of the study.

Disclosure

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.

References

1. Evangelista A, Isselbacher EM, Bossone E, et al. Insights From the International Registry of Acute Aortic Dissection: A 20-Year Experience of Collaborative Clinical Research. *Circulation.*2018;137(17):1846–1860. doi:10.1161/CIRCULATIONAHA.117.031264

2. Park SW, Hutchison S, Mehta RH, et al. Association of painless acute aortic dissection with increased mortality. *Mayo Clin Proc*. 2004;79 (10):1252–1257. doi:10.4065/79.10.1252
3. Sorber R, Hicks CW. Diagnosis and management of acute aortic syndromes: dissection, penetrating aortic ulcer, and intramural hematoma. *Current Cardiology Reports. Springer*. 2022;24:209–216. doi:10.1007/s11886-022-01642-3
4. Upchurch GR, Nienaber C, Fattori R, et al. Acute aortic dissection presenting with primarily abdominal pain: a rare manifestation of a deadly disease. *Ann Vasc Surg*. 2005;19(3):367–373. doi:10.1007/s10016-004-0171-x
5. Pourafkari L, Tajlil A, Ghaffari S, et al. The frequency of initial misdiagnosis of acute aortic dissection in the emergency department and its impact on outcome. *Intern Emerg Med*. 2017;12(8):1185–1195. doi:10.1007/s11739-016-1530-7
6. Lovatt S, Wong CW, Schwarz K, et al. Misdiagnosis of aortic dissection: a systematic review of the literature. *Am J Emerg Med*. 2022;53:16–22. doi:10.1016/j.ajem.2021.11.047
7. Harris KM, Strauss CE, Eagle KA, et al. Correlates of delayed recognition and treatment of acute type A aortic dissection: the International Registry of Acute Aortic Dissection (IRAD). *Circulation*. 2011;124(18):1911–1918. doi:10.1161/CIRCULATIONAHA.110.006320
8. Zhou Y, Yang G, He H, et al. Association between admission time and in-hospital mortality in acute aortic dissection patients: A retrospective cohort study.*Heart Lung*. 2020;49(5):651–659. doi:10.1016/j.hrtlng.2020.04.005
9. Isselbacher EM, 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. *Circulation*. 2022;146:24 e334–e482. doi:10.1161/CIR.0000000000001106
10. Yamaguchi T, Nakai M, Yano T, et al. Population-based incidence and outcomes of acute aortic dissection in Japan. *Eur Heart J Acute Cardiovasc Care*. 2021;10(7):701–709. doi:10.1093/ehjacc/zuab031
11. Zhan S, Hong S, Shan-Shan L, et al. Misdiagnosis of aortic dissection: experience of 361 patients. *J Clin Hypertens*. 2012;14(4):256–260. doi:10.1111/j.1751-7176.2012.00590.x
12. Hsieh TH, Tsai LM, Tsai MZ. Characteristics of and atypical presentations in patients with acute aortic dissection - A single center experience. *Acta Cardiologica Sinica*. 2011;27(4):238–243.
13. Sutratchaichan P. Clinical Presentation and Result of CTA in non-traumatic aortic emergency in Lamphun Hospital. *Lanna Public Health J*. 2015;11(2):28–36.
14. Pitaksuteepong T. Acute aortic dissection in prapokklao hospital. *Prapokklao Hosp Clin Med Educat Center*. 2008;25(2):95–107.
15. Zhong J, Singh AA, Safdar NZ, Nandhra S, Vigneswaran G. CAASP Collaborators. Evaluating current acute aortic syndrome pathways: collaborative acute aortic syndrome Project (CAASP). *BJS Open*. 2024;8(5):zrae096. doi:10.1093/bjsopen/zrae096 PMID: 39298295; PMCID: PMC11412149.
16. Higginson I, Kehoe A, Whyatt J, Smith JE. The 4-hour standard is a meaningful quality indicator: correlation of performance with emergency department crowding. *Eur J Emergency Med*. 2017;24(1):25–28. doi:10.1097/MEJ.0000000000000417
17. Booher AM, Isselbacher EM, Nienaber CA, et al. The IRAD classification system for characterizing survival after aortic dissection. *Ame J Med*. 2013;126(8):730.e19–730.e24. doi:10.1016/j.amjmed.2013.01.020
18. Matthews CR, Madison M, Timsina LR, Namburi N, Faiza Z, Lee LS. Impact of time between diagnosis to treatment in Acute Type A Aortic Dissection. *Sci Rep*. 2021;11:3519. doi:10.1038/s41598-021-83180-6
19. Wundram M, Falk V, Eulert-Grehn JJ, et al. Incidence of acute type A aortic dissection in emergency departments. *Sci Rep*. 2020;10. doi:10.1038/s41598-020-64299-4
20. Salari N, Morddarvanjoghi F, Abdolmaleki A, et al. The global prevalence of myocardial infarction: a systematic review and meta-analysis. *BMC Cardiovasc Disord*. 2023;23(1):1–12. doi:10.1186/s12872-022-03030-9
21. Kim RB, Kim JR, Hwang JY. Epidemiology of myocardial infarction in Korea: hospitalization incidence, prevalence, and mortality. *Epidemiol Health*. 2022;44:1.
22. Pape LA, Awais M, Woznicki EM, et al. Presentation, diagnosis, and outcomes of acute aortic dissection: 17-year trends from the international registry of acute aortic dissection. *J Am Coll Cardiol*. 2015;66(4):350–358. doi:10.1016/j.jacc.2015.05.029
23. Hibino M, Otaki Y, Kobeissi E, et al. Blood pressure, hypertension, and the risk of aortic dissection incidence and mortality: results from the J-SCH study, the UK biobank study, and a meta-analysis of cohort studies. *Circulation*. 2022;145:633–644. doi:10.1161/CIRCULATIONAHA.121.056546
24. Hirata K, Wake M, Takahashi T, et al. Clinical predictors for delayed or inappropriate initial diagnosis of type A acute aortic dissection in the emergency room. *PLoS One*. 2015;10(11):e0141929. doi:10.1371/journal.pone.0141929 PMID: 26559676; PMCID: PMC4641684.
25. Briggs B, Cline D. Diagnosing aortic dissection: a review of this elusive, lethal diagnosis. *J Am Coll Emerg Physicians Open*. 2024;5(4):e13225. doi:10.1002/emp2.13225 PMID: 38983974; PMCID: PMC11231041.
26. Faridaalaee G, Fathi N, Shahsavarinia K, Zarei H, Yousefifard M. Incidence and outcomes of aortic dissection in Tabriz, Iran; a longitudinal study of 150 cases. *Arch Acad Emerg Med*. 2024;12(1):e40. doi:10.22037/aaem.v12i1.2314