

## Recognition and diagnosis of acute type A aortic dissection in a large Belgian referral center – can we do better?

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### Abstract

**Background:** Acute type A aortic dissection (ATAAD) has a poor prognosis unless promptly diagnosed and surgically treated. As ATAAD is relatively rare and clinical presentation may mimic other pathologies, diagnosis can be challenging.

**Objectives:** The aim of this study is to evaluate the difficulties in diagnosing ATAAD.

**Methods:** A monocentric, retrospective analysis was conducted of all patients undergoing surgical repair for acute type A aortic dissection in our hospital (a large Belgian referral center) between the 1st of January 2016 and the 31st of December 2020. Data were collected regarding patient's demographics i.e. age and gender, time of first medical contact, referral from other hospitals, presenting symptoms, initial diagnosis, inappropriate antiplatelet or antithrombotic therapy, time to the correct diagnosis, time to initiate surgical repair, and one-year mortality.

**Results:** Thirty-three patients were included. We found that a correct initial diagnosis was only made in twelve percent of patients with ATAAD. In twenty-one percent of patients, misdiagnoses led to inappropriate administration of antiplatelet or antithrombotic drugs pre-operatively. There was a difference in time from first medical contact to initiation of surgical repair between referred and non-referred patients. This time interval tended to be shorter in the latter group.

**Conclusions:** The main finding of this analysis is the delayed diagnosis of ATAAD in the majority of patients. This trend is slightly higher in patients referred from other hospitals. To improve outcome in ATAAD, efforts should be made to increase awareness for the presenting symptoms, and appropriate diagnostic imaging should be performed in a timely manner.

**Keywords:** Aortic Dissection, Diagnosis, Platelet Aggregation Inhibitors.

### Background

Acute aortic dissection involving the ascending aorta (Stanford classification type A/DeBakey classification type I and II) is a medical emergency. Prognosis for acute type A aortic dissection (ATAAD) is very poor unless promptly diagnosed and surgically treated. Twenty percent of patients with ATAAD die before reaching the hospital, with in-hospital mortality rates of approximately 30%<sup>1-3</sup>. Left untreated, the immediate mortality rate increases by 1-2% per hour over the first hours, leading to a mortality of 50% within 24 hours and 66% at 1 week<sup>1,4-7</sup>. Untreated patients die from complications related to the dissection, including

aortic rupture, acute myocardial infarction, cardiac tamponade, and end organ malperfusion<sup>1,8</sup>. Early diagnosis and surgical treatment are therefore critical for survival<sup>9</sup>.

However, correct diagnosis in ATAAD is not obvious, since this condition is relatively rare and clinical presentation may mimic more common pathology. The incidence of type A dissection is reported to be 2.5-6 per 100.000 per year<sup>10,11</sup>. Most patients with acute type A dissection present with sudden, 'tearing' chest pain with or without symptoms of malperfusion due to impaired flow in end-organ arteries.

As acute chest pain is present in 85% of patients and ECG may indicate ischemia, patients with

acute type A dissection are frequently suspected of an acute coronary syndrome<sup>10,12</sup>. This not only delays correct diagnosis, but also leads to treatment with antiplatelet or antithrombotic drugs causing perioperative bleeding complications later on<sup>5,13</sup>. In the absence of chest pain, signs of malperfusion may be the only presenting symptom<sup>14</sup>. Depending on the affected organ(s), diagnosis might be very challenging. Both intestinal and renal ischemia are most difficult to detect. Cerebral ischemia or paraplegia are the presenting symptoms in rare cases<sup>15</sup>. These (focal) neurologic deficits may mimic stroke and may lead to treatment with antithrombotic therapy<sup>16</sup>.

Despite widely available diagnostic tools, considerable diagnostic delay or initial misdiagnosis are frequently reported in patients with ATAAD. Data from the International Registry of Acute Aortic Dissection (IRAD) shows that delayed or initial misdiagnosis of ATAAD accounts for 16%–39% of cases<sup>12,17</sup>. The median time from arrival in the emergency department to correct diagnosis is reported to be 4.3 hours<sup>5,18</sup>. In the context of ATAAD, this delay might have a significant impact on outcome. Similar time delays were reported in other studies<sup>19,20</sup>.

Large international databases on the presentation, diagnosis, treatment, and outcome of ATAAD are IRAD (International Registry of Acute Aortic Dissection), GERAADA (German Registry for Acute Aortic Dissection type A) and NORCAAD (Nordic Consortium for Acute type A Aortic Dissection)<sup>1,5,8,18,21-23</sup>. Literature based on these databases mainly focuses on surgical treatment and outcome.

The focus of the study is to address the difficulties still encountered when diagnosing ATAAD. The initial presentation and delay in diagnosis in patients undergoing surgical repair for type A aortic dissection in a large Belgian referral center were examined. Common misdiagnosis and the incidence of inappropriate administration of antiplatelet therapy were identified.

This retrospective analysis intends to evaluate the performance with regards to the correct and timely diagnosis of patients with acute type A aortic dissection, which would allow to identify the missing or erroneous links in the diagnostic chain. This would eventually lead to an improvement of the diagnostic strategy.

## Methods

### *Patient selection and data collection*

We performed a monocentric, retrospective analysis of all patients who had undergone surgical repair

for an acute type A aortic dissection in our hospital (a large referral center) between the 1st of January 2016 and the 31st of December 2020. Acute type A aortic dissection was defined as a dissection with the involvement of the ascending aorta proximal to the truncus brachiocephalicus diagnosed within 14 days after onset of symptoms. A period of 5 years was chosen since acute type A aortic dissection is relatively uncommon. Forty-one patients diagnosed with ATAAD were surgically treated in this period. Eight patients were excluded from our analysis. In three patients, data from the referring hospital could not be obtained. Three patients underwent elective TEE, showing an intima-tear of the ascending aorta. In one patient ATAAD was iatrogenic during coronary angiography. One patient initially presented with a type B aortic dissection, which evolved in a type A aortic dissection. The sickest patients with type A dissection often die in a pre-hospital setting or in the emergency department and therefore were not included in this study. Patients who were not considered for surgery because of age, frailty or comorbidities were not included either.

Data was collected from the existing medical records starting from the first medical contact associated with the ATAAD to 1 year after surgery. We collected data regarding patient's demographics i.e. age and gender, time of first medical contact, referral from other hospitals, presenting symptoms, initial diagnosis, (inappropriate) treatment with antiplatelet or antithrombotic therapy, time to correct diagnosis, time to initiation of surgical repair, and one-year mortality. Data was collected between the 1st of October 2021 and the 31st of December 2021. The analyzed medical data were already part of the medical record. The medical data were collected by the Ziekenhuis Oost-Limburg or by the referring center. All data were handled with confidentiality during the project and only the information relevant to our research question was extracted from the patient's medical records.

### *Statistical analysis*

The obtained data were qualitative as well as quantitative data. The method to analyze these data is descriptive analysis. Age in years is described using mean and standard deviation. Gender, initial diagnosis (i.e., coronary syndrome, neurologic disorder...) and inappropriate use of antiplatelet therapy pre-operatively (yes/no) are displayed as a number and percentage. Time between first medical contact and initiation of surgical treatment is subdivided in different categories (< 2 hours, 2 to 4 hours, 4 to 24 hours and > 24 hours) and we described which percentage of patients was correctly diagnosed in that timeframe. The one-

year mortality and the number of patients referred from other hospitals are also represented as numbers and percentage.

This retrospective study was approved by the Ethics Committee of Ziekenhuis Oost-Limburg (Schiepse Bos 6, Genk) on the 6th of October 2021.

## Results

### *Demographic characteristics and number of referred patients*

We retrospectively analyzed data from 33 patients who had undergone surgical repair for acute type A aortic dissection in our hospital between the 1st of January 2016 and the 31st of December 2020.

Mean age of the analyzed patients was  $63.7 \pm 12.7$  years with the youngest being 18.26 years and the oldest 80.52 years. Twenty-three patients (70%) were male. Seven patients (twenty-one percent) who underwent surgical repair for ATAAD in our hospital were referred from another hospital (see Table I).

### *Presenting symptoms and initial diagnosis*

Twenty-seven percent of patients (9 patients) presented with retrosternal chest pain as their sole complaint. Thirty-six percent (12 patients) had thoracic pain combined with abdominal and/or interscapular pain at arrival in the emergency department. In 4 patients (12%), neurological symptoms were the only presenting symptoms.

Nineteen percent of patients (6 patients) presented with a combination of neurological symptoms and thoracic, abdominal and/or interscapular pain. Two patients (6%) had other initial symptoms i.e. pain in the left arm without any other complaints and out-of-hospital cardiac arrest.

Correct initial diagnosis was made in only 4 patients (12%) with ATAAD. In twenty-seven percent of patients, initial diagnosis was not specified in the patient's medical record. This means that in at least sixty-one percent of patients, initial diagnosis was incorrect. In twenty-seven percent of patients, symptoms were attributed to acute coronary syndrome (acute myocardial infarction, unstable angina). Fifteen percent were initially diagnosed with a primarily neurologic disorder (cerebrovascular accident, transient ischemic attack, epileptic seizure and lumbar hernia). In one patient (4%), pulmonary embolism was the initial diagnosis. Symptoms in the remaining fifteen percent of patients were attributed to a variety of pathologies such as pancreatitis, the combination of angina with a pancreatic cyst, upper extremity deep vein thrombosis, bradycardia e causa ignota and urolithiasis (see Table I).

### *Incorrect use of antiplatelet/antithrombotic therapy*

In twenty-one percent of patients (7 patients) misdiagnoses led to inappropriate administration

**Table I.** — Demographic characteristics, presenting symptoms, initial diagnosis, antiplatelet or antithrombotic therapy pre-operatively, one-year mortality and number of referred patients.

Age (years)		$63.7 \pm 12.7$	
		Number of patients	Percentage
Gender	Male	23	70%
	Female	10	30%
Presenting symptoms	Retrosternal chest pain	9	27%
	Thoracic/abdominal/interscapular pain	12	36%
	Neurological complaints	4	12%
	Neurological complaints accompanied with pain	6	19%
	Others	2	6%
Initial diagnosis	Coronary syndrome	9	27%
	Neurological disorder	5	15%
	Pulmonary embolism	1	4%
	ATAAD	4	12%
	Other	5	15%
	Unknown	9	27%
Antiplatelet or antithrombotic therapy pre-operatively		7	21%
30-day mortality		6	18%
1-year mortality		8	24%
Number of patients referred from other hospitals		7	21%

of antiplatelet or antithrombotic therapy pre-operatively. In four patients, the initial diagnosis was acute coronary syndrome. Two of the patients were misdiagnosed with a neurological disorder i.e. cerebrovascular accident and transient ischemic attack. In one patient, the initial diagnosis was a deep vein thrombosis. In four out of these seven patients, the antiplatelet/antithrombotic agent administered was lysine acetylsalicylate. Two patients received thrombolysis (t-PA) and one patient low-molecular weight heparins (LMWH) (see Table I).

#### *Time between first medical contact and correct diagnosis*

Median time between first medical contact and correct diagnosis was 2.6 (IQR 1.2 – 9.4) hours. For non-referred patients, median time to correct diagnosis was 2.58 hours. In referred patients, correct diagnosis was made in a median time of 6 hours (see Table II).

#### *Time between first medical contact and initiation of surgical repair*

We subdivided time between first medical contact and initiation of surgical repair in time intervals. Overall, the median time to initiation of surgery was 4.4 (IQR 1.9 – 16.8) hours. Median time to initiation of surgical repair was 20.2 hours for referred patients versus 3.3 hours for non-referred patients.

In the referred patients, surgery could be started within 4 hours after diagnosis in 54% of patients, whereas in 71% of the non-referred patients, surgery could not be started earlier than 4 hours after diagnosis.

#### *Thirty-day and one-year mortality*

Thirty-day mortality was eighteen percent ( $n = 6$ ). One-year mortality was twenty-four percent ( $n = 8$ ).

## Discussion

This study shows that there are still many difficulties with diagnosing acute type A aortic dissection. In the last 5 years, at least sixty-one percent of patients surgically treated for an ATAAD had an incorrect initial diagnosis. Since the most common presenting symptom was retrosternal chest pain, the misdiagnosis of coronary syndrome was made in more than a quarter of patients. Inappropriate administration of antiplatelet and/or antithrombotic therapy occurred in one fifth of patients, increasing the risk of perioperative bleeding complications. The correct diagnosis was made after a median time of 2.6 hours, with extremes of 78 hours after first medical contact. We also found that one third of the patients diagnosed in our tertiary hospital received surgical treatment in less than two hours after presentation at the emergency department. When diagnosed in a referring hospital however, almost half of the patients received correct treatment more than 24 hours after first medical contact. This difference could have had a significant impact on the outcome.

These results show that there are improvements to be made in diagnosing acute type A dissection. CT-imaging of the thoracic aorta was often delayed, even though the complaints could not be attributed to other causes. This seems to occur in a large number of patients from referring hospitals. Besides the correct diagnosis being delayed at referring hospitals, the transfer of patients could also contribute to the longer time intervals before surgical treatment. A request for transfer and inter-hospital transport needs to be organized in a timely manner. Not only the logistics can be challenging. Patients could be hemodynamically unstable, for which stabilization is required before safe transportation is possible.

No conclusions can be drawn from the one-year mortality. Firstly, the number of patients is too

**Table II.** — Time between first medical contact and correct diagnosis and time between first medical contact and initiation of surgical repair.

Time between first medical contact and correct diagnosis	Non-referred patients		Referred patients		Total	
Mean	10.31 hours		22.16 hours		12.81 hours	
Median	2.58 hours		6 hours		2.6 hours (IQR 1.2 – 9.4)	
Time between first medical contact and surgical repair	Non-referred patients		Referred patients		Total	
< 2 hours	9	35%	0	0%	9	28%
2-4 hours	5	19%	2	29%	7	21%
4-24 hours	8	31%	2	29%	10	30%
> 24 hours	4	15%	3	42%	7	21%

small, and the incidence of mortality is not frequent enough. Secondly, as previously stated, patients who did not receive surgical treatment are not included in our database. This means that patients with ATAAD who died prehospital or at the emergency department were not taken into account. We did not examine the difference in mortality between referred and non-referred patients. Hemodynamically unstable patients or patients with organ malperfusion were transferred preferably to a tertiary center i.e. our hospital, thus possibly increasing mortality of the non-referred patients.

Most of our findings are consistent with the literature. The most frequent symptom in ATAAD is acute chest pain, present in around 80% of patients according to the literature<sup>1,5</sup>. The presence of neurological symptoms is comparable with 20.3% of patients in the GERAADA registry<sup>24</sup>.

In our study, median time to the correct diagnosis was 2.6 hours. This is slightly better than reported in other studies (median time between four and five hours). In referred patients however, median time was six hours. As a result, time to initiate surgical repair was increased in patients presenting at a non-tertiary center. These differences are in line with results in other research papers<sup>18</sup>.

Due to large international studies and registries, more data on acute type A aortic dissection, diagnosis and treatment is available. This study is in line with these results: correct and timely diagnosis is still challenging. Clinicians working in the emergency department need to be aware of the diagnostic pitfalls in patients with ATAAD. There needs to be a higher index of clinical suspicion, and a low threshold for CT imaging of the thoracic aorta is necessary.

There are several limitations to this study. We examined only patients who underwent surgery for acute type A aortic dissection in our hospital in the last five years. As mentioned before, this means that the sickest patients who died pre-hospital or in the emergency department were not included in this study. Patients who were ineligible for surgical treatment because of age, frailty or comorbidities were not included in our database either, leading to bias and underestimation of the lethality of ATAAD. Our study thus only comprised thirty-three patients, with seven patients being referred from another hospital. It was never the intention to draw statistically significant conclusions from this database, only to identify missing or erroneous links in the diagnostic chain.

The main finding of this study is the belated diagnosis of ATAAD in the majority of patients. This trend is mainly seen in referring hospitals. To improve outcome in ATAAD, measures should

be taken to increase awareness of the presenting symptoms, and appropriate diagnostic imaging should be performed timely.

## Conclusion

The key to success in the treatment of type A dissection is rapid surgical repair before hemodynamic instability or deterioration. Misdiagnosis not only leads to delayed surgery, but also affects surgical outcome due to inappropriate use of antiplatelet or antithrombotic therapy. Even specialist tertiary centers where ATAAD is managed, seem to experience problems in timely diagnosing ATAAD. Although they tend to do better than smaller institutions without experience in cardiac surgery. Efforts should be made to improve training emergency physicians in recognition of the presentation of acute type A dissection. A high index of suspicion and a low threshold for imaging of the thoracic aorta is critical. Despite the relative rarity of an acute type A aortic dissection, it is a life-threatening event in which early recognition and management are crucial to improve mortality.

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**Ethics approval:** This retrospective study is approved by the Ethics Committee of Ziekenhuis Oost-Limburg that operates according to the ICH-GCP principles.

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