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Clinical Characteristics of Aortic Aneurysm and Dissection as a Cause of Sudden Death in Outpatients

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Abstract

Objective—To describe characteristics of non-hospitalized patients experiencing sudden death from aortic causes and compare with characteristics of patients experiencing non-traumatic, unexpected, outpatient death from other causes.

Methods—Retrospective case control analysis of patients aged 18–65 with non-traumatic, unexpected, outpatient cardiac arrest, emergency department resuscitation attempts, and autopsy-determined cause of death. Demographics, prodromal symptoms, and arrest characteristics were examined and univariate comparisons between aortic and non-aortic death patients were performed.

Results—384 met inclusion criteria. Aortic pathology represented 4.4% of patients (12 dissections, 5 aneurysms). Preexisting aortic disease (n=2) and antemortem suspicion of an aortic cause (n=3) were uncommon. Aortic death patients often had prodromal symptoms (53%; 28–77%) and hemopericardium (47%; 23–72%), were older, and were more likely to have a pulse in the ED, pulseless electrical activity, and witnessed arrest by a medical provider.

Conclusion—In this sample of outpatients with cardiac arrest from aortic disease, death was not instantaneous and hemopericardium was common in many patients with dissection.

Keywords

aortic dissection; aortic aneurysm; sudden death; cardiac arrest; autopsy

Introduction

Aortic dissection and aneurysm are commonly discussed and feared in the differential diagnosis of a wide variety of emergency department (ED) chief complaints. Aortic pathology is known to potentially cause fatality and disability.[1–5] Critically ill patients may present to the ED or Emergency Medical Services (EMS) without a known history of aortic disease or may simply present in undifferentiated shock or cardiac arrest.[1,6] Despite the fact that physicians and EMS providers are commonly taught to consider aortic dissection and aneurysm as potential life threats, little is known about clinical characteristics of sudden death from aortic pathology in the ED or pre-hospital setting, and the diagnosis is often missed.[7]

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Symptoms from aortic disease include back pain, chest pain, and abdominal pain, all of which can closely resemble symptoms of other emergent problems such as pulmonary embolism, myocardial infarction, and mesenteric ischemia.[6] At times patients may be too unstable to allow for a complete history, exam, and diagnostic testing. However, rapid simultaneous resuscitation and evaluation must occur even in the context of shock or near arrest. A description of clinical characteristics of sudden death from aortic disease may be a helpful first step toward efforts to more rapidly and efficiently identify these patients in the ED or EMS environment.

Whereas most of the current literature describes patients who survive the ED and progress to the OR or ICU,[2,3,5] the present study focuses on subjects who experience sudden death in the ED or pre-hospital setting. The aim of the current study is to describe clinical characteristics of outpatients who suffer sudden death from clear autopsy proven aortic dissection or aneurysm and compare these characteristics with subjects experiencing sudden death from other non-traumatic causes.

Methods

Study Design

All data were abstracted from records at the Mecklenberg County, North Carolina, Medical Examiner's (ME's) Office. This retrospective case control study was approved and considered exempt from informed consent by the Northwestern University Institutional Review Board.

Study Setting and Population

Mecklenberg County contains the city of Charlotte, North Carolina and is an urban center in the southeastern United States. The ME's Office reviews all cases of outpatient sudden death (ED or out-of-hospital) without clear cause using past medical records, EMS records, ED records, autopsy results, and family interviews. The ME's records can, therefore, function as an important source of information about outpatients who suffer unexpected sudden death that is not due to known terminal illness.

Study Protocol

The database was created by a hand review of all ME reviewed deaths from 1992 to 1999 to identify cases of outpatient sudden death from medical causes. Included subjects met the following criteria: age 18–65 years, autopsy performed, non-traumatic death, outpatient, transported to an ED. Patients were excluded if review indicated death obviously due to suicide, burns, fire, GI hemorrhage, external hemorrhage, or toxins. Data were abstracted into a preformed data collection instrument and included EMS records, ED physician and nursing records, and ME interviews with family, witnesses, and physicians regarding antemortem events and prior medical conditions.

All subjects had a complete autopsy performed with gross dissection of all solid organs, including the brain and heart, and examination of all body cavities. Specific notation was made by the pathologist if cardiac tamponade, hemothorax, or any extension of dissection into the carotid arteries was present.

The database was separated into cases (those with aortic aneurysm or dissection on autopsy) and controls (those with sudden death due to other causes).

Key Outcome Measures

The database was reviewed and the characteristics of each aortic case noted including demographics, type of aortic process, anatomic location, cardiac involvement, presence of

pulse upon first contact with medical provider, presence of pulse upon ED arrival, primary arrest rhythm, return of spontaneous circulation, chest pain, abdominal pain, neurological deficits (including seizure, syncope, focal neurological deficits, and altered mental status), known history of aneurysm, known history of dissection, and, if present, any disease specific primary antemortem assessments noted by the treating physician. Chest pain, abdominal pain, and neurological deficits were included in the database if reported by family, witnesses, or medical personnel.

The records of both the cases and controls were reviewed and compared. The factors compared included mean age, gender, chest pain, abdominal pain, neurological symptoms, record of pulse upon ED arrival, first arrest rhythm, whether it was witnessed, and whether it was witnessed by a medical provider.

Data Analysis

Means and standard deviations are given for continuous data. Univariate comparisons between subjects with aortic causes of death and subjects with non-aortic causes of death were performed. Proportions and differences between groups are described with 95% confidence intervals.

Results

During the study period, 384 subjects met the inclusion criteria and were brought to an ED for resuscitation attempts. They ultimately expired in the ED and had a complete autopsy to determine cause of death. The mean age was 49.5 (+/− 10) years and 73.2% were male. The most common cause of death was coronary artery related etiology comprising 59.6% of all deaths. The next most common single cause was pulmonary embolism comprising 9.6% of deaths (Table 1).

Aortic pathology represented 4.4% of all 384 deaths (n= 17). Twelve were due to dissection and 5 were due to aneurysm rupture. In all 17 of these cases the aortic pathology was noted by the medical examiner as the unequivocal cause of death. Only 2 of the 17 cases of sudden death from aortic pathology had known pre-existing diagnosis of aortic pathology as confirmed by interview with family and review of medical records. Evaluation of the ED records to determine antemortem suspicion for aortic pathology indicated that in 2 of the 12 cases of dissection the ED physician documented suspicion for dissection and in 1 of the 5 aneurysm cases the ED physician documented suspicion for aneurysm. In all 3 of these cases the patients had a pulse upon arrival to the ED, or, in the aneurysm case, upon return of spontaneous circulation in the ED. Five of the 17 patients experiencing aortic sudden death (29.4%) had a pulse at the time of EMS arrival and 4 of 17 (23.5%) had a documented pulse upon arrival to the ED. Patients with aortic dissection presented with: abdominal pain (n=1), headache (n=1), altered mental status (n=2), syncope (n=1), seizures (n=2), diaphoresis (n=1), and left hemiparesis with right neck pain (n=1). Patients with death from aortic aneurysm presented with abdominal pain (n=2) (Table 2).

When comparing the patients with aortic death to the patients with other causes of medical non-traumatic sudden death several differences were noted. The aortic death patients were statistically older (mean age 51.1 vs. 45.7; 95% CI for difference 0.4 to 10.3%). They were also more likely to have a pulse in the ED (23.5% vs. 2.8%; 95% CI for difference 0.5 to 41.0%), and an arrest rhythm of pulseless electrical activity (PEA) (41.2% vs. 12.3%; 95% CI for difference 5.3 to 52.5%). Additionally, their deaths were more likely to be witnessed by a medical provider (35.3% vs. 11.7%; 95% CI for difference 0.6 to 46.5%) (Table 3).

Discussion

We report the first case series and comparison study of autopsy proven sudden death from acute aortic emergencies in the ED setting. Despite significant teaching that aortic 'catastrophies' can lead to sudden death, little is known about the clinical and pathological characteristics of these events. Our report suggests several significant findings:

Death from aortic disease is not instantaneous in these subjects. We describe that over half of these patients (9/17) had prodromal symptoms of either chest pain, abdominal pain, or neurological dysfunction, suggesting that recognition of aortic pathology may be possible. Also, a third of the arrests were witnessed by EMS or the ED physician. A gradually evolving arrest is also supported by the preponderance of PEA as the primary rhythm of sudden death from aortic pathology, consistent with previous reports.[1] Pulseless electrical activity was statistically more prevalent as the primary arrest rhythm from aortic causes as compared to non-aortic causes (41.2% vs. 12.3%, Table 3).

Textbooks and previous studies typically suggest that death from aortic dissection can occur from retrograde dissection and resultant hemopericardium and tamponade.[1,5,8] This series provides evidence supporting this mechanism as a final common pathway of death from dissection. Of the12 cases of dissection in this series, 8 had hemopericardium at autopsy. Three others had mediastinal or pleural hemorrhage.

Despite the fact that our study was not aimed to provide power to discriminate between aortic and non-aortic causes of sudden death, several trends and hypothesis generating differences were observed. Patients with death from aortic causes were statistically more likely to have PEA as the arrest rhythm, an arrest witnessed by either an ED physician or EMS personnel, and a pulse at the time of ED arrival. It is unlikely that clinicians would use arrest rhythm alone to diagnose an aortic cause of arrest, but these findings may provide support for clinicians to consider aortic pathology as among the most likely considered diagnoses. This may have implication if return of spontaneous circulation occurs or if it prompts additional bedside imaging.

These data support the use of bedside ED ultrasound as a first measure in shock suspicious for dissection or any PEA cardiac arrest to look for evidence of tamponade[9] or free fluid in abdomen. We note that 2/3 of the dissection subjects had hemopericardium, and all of the aneurysm subjects had hemoperitoneum. Although needle decompression may only be temporizing, it is a recommended immediate therapy for suspected tamponade and may be the only way to prevent these patients from deteriorating immediately to unsalvageable cardiac arrest.[10]

Our report is limited in several ways. This is a select sample of patients who were referred to the medical examiner office for evaluation of cause of sudden death. It is possible and indeed likely that this sample is not representative of all subjects with outpatient sudden death from aortic pathology due to exclusion of patients over 65 years of age. In this medical examiner system as well as most others, patients with non-traumatic medical arrest above 65 years of age rarely if ever had an autopsy performed, and as the outcome focus of our work was clear, unambiguous determination of cause of death, this cutoff was used. This work likely underestimates both the age and the true prevalence of this disease as a cause of death in ED patients due to this fact. This is also derived from a single metropolitan area and may not be generalizable to other locations. Despite this possibility, we note that our sample was ethnically diverse and came from over 6 hospitals including academic and community centers. Finally, we note that due to the number of subjects with aortic pathology our work is not adequately powered to measure all clinically significant potential differences in characteristics between

aortic and non-aortic medical sudden death. Future work pooling data from several sites would improve both generalizability and power.

In conclusion, all 384 patients in this sample were brought to an ED, suffered unexpected, non-survivable cardiac arrest, and had attempts at resuscitation with autopsy determined cause of death. We report a prevalence of aortic pathology as causal in 4.4% of these subjects. Of the aortic sudden death patients, over half had prodromal symptoms of chest pain, abdominal pain, or neurological dysfunction. PEA as the arrest rhythm was seen in over a third of aortic subjects, and a third had their arrest witnessed by either an ED physician or and EMS provider.

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Table 1

General characteristics of the sample of ED outpatient sudden death

Demographics:	**Total N=384**	**Percent**	**95% CI**
Mean Age (years)	45.9 (SD+/− 10)		44.9yrs to 46.9yrs
male	281	73.2	68.4% to 77.5%
Caucasian	214	62.2	56.8% to 67.4%
African American	124	36.0	31.0% to 41.4%
other race*	6	1.7	0.6% to 3.8%
Cause of Death:			
Acute Coronary Syndrome	229	59.6	54.5% to 64.6%
Pulmonary Embolism	37	9.6	6.9% to 13.0%
Arrhythmia	28	7.3	4.9% to 10.4%
Aortic pathology	17	4.4	2.6% to 7.0%

* Race data unavailable or unclear for 40 subjects.

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Table 2

Clinical characteristics of patients experiencing aortic sudden death

Description	Cause of death	Pulse at ED arrival	Arrest rhythm	ROSC in ED	Chest pain	Abdominal pain	Neuro signs	ED MD assessment prior to autopsy
49yo male; arrested in the ED after altered mental status, seizure, R neck pain, L hemiparesis, ST depression on ECG	Aortic **dissection** hemopericardium, R common carotid dissection	yes	VF	2 times	no	no	yes	aortic dissection
19yo male; history of renal failure, renal transplant; arrived at ED with chest pain; subsequent ED arrest	Aortic **disection**, hemopericardium, autopsy evidence of previous PDA ligation	yes	VF	no	yes	no	no	aortic dissection
57yo male; chest pain, dyspnea, diaphoresis; then arrest witnessed by bystander; ROSC by EMS with pulse at arrival to ED; subsequent arrest in ED	Aortic **dissection**, hemopericardium	yes	PEA	yes	yes	no	no	none
62yo female; abdominal pain, altered mental status, syncope, ECG with ST depression, then ST elevation prior to arrest in the ED	Aortic **dissection**, hemopericardium	yes	PEA	no	no	yes	yes	none
48yo female; headache and seizure; brought to ED by family; VF at ED arrival	Aortic **dissection**, hemopericardium	no	VF	no	no	no	yes	cardiac arrest
50yo female; witnessed by bystander; no pulse on EMS arrival	Aortic **dissection**, hemopericardium, carotid dissection, medistinal hemorrhage	no	VF	no	no	no	no	cardiac arrest
39yo male; not witnessed	Aortic **dissection**, medistinal hemorrhage	no	PEA	no	yes	no	no	none
51yo male; witnessed by bystander,	Aortic **dissection**, hemopericardium	no	VF	no	yes	no	no	none

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Description	Cause of death	Pulse at ED arrival	Arrest rhythm	ROSC in ED	Chest pain	Abdominal pain	Neuro signs	ED MD assessment prior to autopsy
clutched chest and arrested								
60yo male; not witnessed	Aortic **dissection**, hemopericardium	no	VF	no	no	no	no	none
65yo female; history of abdominal aortic aneurysm repair; bystander witnessed arrest	Aortic **dissection**, hemothorax.	no	PEA	no	no	no	no	PE
58 yo male; witnessed by bystander	Aortic **dissection**, extension to carotid & subclavian.	no	PEA	no	no	no	no	none
41yo female; history of ascending aortic dissection repair with graft 9 mo prior; dyspnea; then arrest witnessed by EMS	Aortic **dissection** (descending), rupture into R pleural space with hemothorax	no	PEA	no	no	no	no	none
32yo male; exercising; arrest witnessed by bystander	Aortic **aneurysm** rupture (ascending) with Hemopericardium.	no	AS	no	no	no	no	PE vs. AMI
60yo male; abdominal pain; arrest witnessed by EMS	Abdominal aortic **aneurysm** rupture	no	PEA	no	no	yes	no	none
63yo male; found in car pulled over in cardiac arrest	Abdominal aortic **aneurysm** rupture	no	AS	no	no	no	no	none
56yo male; abdominal pain; arrest witnessed by bystander	Abdominal aortic **aneurysm** rupture	no	AS	yes	no	yes	no	Ruptured AAA
58yo male; arrest witnessed by bystander	Thoracic aortic **aneurysm** rupture, hemopericardium	no	AS	no	no	no	no	none

AAA=abdominal aortic aneurysm, AMI=acute myocardial infarction, AS=asystole, ECG=electrocardiogram, ED=emergency department, EMS=Emergency Medical Service, L=left, MD=medical doctor PE=pulmonary embolism, PDA=patent ductus arteriosus PEA=pulseless electrical activity, R=right, ROSC=return of spontaneous circulation, VF=ventricular fibrillation

Table 3

Clinical characteristics of death from aortic causes compared to death from non-aortic medical causes

	Aortic sudden death	Non-Aortic sudden death	Difference between groups	95% confidence interval for difference
Mean Age (years)	**51.1 (46.2–55.8)**	**45.7 (44.6–46.7)**	**5.4**	**0.4 to 10.3 (t-test)**
Male	12/17 (70.6%)	269/367 (73.3%)	−2.7%	−24.8% to 19.4%
Chest Pain	4/17 (23.5%)	83/367 (22.6%)	0.9%	−19.7% to 21.5%
Abdominal Pain	3/17 (17.6%)	30/367 (8.2%)	9.4%	−8.9% to 27.8%
Neurological symptom	3/17 (17.6%)	42/367 (11.4%)	6.2%	−12.2% to 24.6%
ED Pulse upon arrival	**4/17 (23.5%)**	**10/361 (2.8%)**	**20.7%**	**0.5% to 41.0%**
PEA as first arrest rhythm	**7/17 (41.2%)**	**45/367 (12.3%)**	**28.9%**	**5.3% to 52.5%**
Witnessed arrest	14/17 (82.4%)	234/367 (63.8%)	18.6%	−0.2% to 37.4%
Witnessed arrest by a medical provider	**6/17 (35.3%)**	**43/367 (11.7%)**	**23.6%**	**0.6% to 46.5%**
ROSC in ED	3/17 (17.6%)	13/367 (3.5%)	14.1%	−4.1% to 32.3%

Statistically significant differences in bold

ED=emergency department, PEA=pulseless electrical activity, ROSC=return of spontaneous circulation