Aortic dissections, aneurysms and ruptures: An emergency perspective

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The goals of this (research article) presentation are to review aortic dissections, aneurysms and ruptures, review the anatomy and physiology of the aorta, discuss differing presentations and the challenges faced with diagnoses in the emergency department. This article will highlight the importance of our nursing assessments and our ability to direct physicians and diagnostics appropriately, thereby positively influencing patient diagnosis, treatments and outcomes.

The aorta is the largest blood vessel in the body. It is usually about one foot in length and one inch in diameter. It originates in the left ventricle of the heart and extends down the length of the abdomen, ending in a bifurcation into the common iliac arteries that supply blood to the legs.

The aorta functions to distribute oxygenated blood to the entire body through systemic circulation.

The aorta is divided broadly into four parts: the ascending aorta, the aortic arch, the thoracic descending aorta and the abdominal descending aorta. The branches of the ascending aorta supply the heart, the branches from the aortic arch supply the head, neck and arms. Branches of the thoracic descending aorta supply the chest (except for the heart and the respiratory zone of the lungs) and branches of the abdominal aorta supply the abdomen and its organs. The common iliac arteries supply the legs and pelvic area.

Ascending aorta: This portion supplies blood to the heart through the right and left coronary arteries.

Aortic arch: Has three main branches—the brachiocephalic trunk (this feeds the right side of the head, neck, right chest wall and arm), the left common carotid and the left subclavian artery, which feeds the left side of the head, neck, left chest wall and left arm.

Thoracic descending aorta: This portion of the aorta feeds the intercostal and subcostal arteries and the left bronchial arteries. These vessels supply blood to the esophagus, mediastinum, pericardium and the diaphragm.

Abdominal descending aorta: This portion begins at the diaphragm and feeds the lumbar and renal arteries, suprarenal and visceral arteries and, therefore, supplies blood to the diaphragm, stomach, intestines, liver, spleen, pancreas and the reproductive organs.

The aorta, like all arteries, has several layers that are further divided into: intima, media and adventitia. A weakening of the arterial wall can occur anywhere and on any layer, though the majority of the time it is the intimal layer. This weakening develops into an aneurysm or the vessel wall sustains a tear and there is bleeding between the layers... a dissection. The location determines the type, i.e.: aortic arch tear, thoracic aneurysm or abdominal aortic aneurysm (AAA).

An aneurysm, by definition, is a sac formed by the dilation of the walls of the artery, a ballooning. They may be "berry-like" or "spindle-shaped" fusiform, which are the ones most likely to form with a dissection.

With an aneurysm or dissection, blood is diverted from circulation into an expanding mass or hematoma, which, depending on the location, creates an obstruction and decreases flow to the area or organs with associated symptoms. The dissection decreases circulating volume, decreasing cardiac output and decreasing end-organ perfusion, as a result. This diversion of blood can extend up or down the aorta and, if it goes "up"-retrograde, may result in blood in the pericardium and a resultant cardiac tamponade.

Aortic dissections are a diagnostic challenge. It is important to have a high index of suspicion to increase the accuracy of your diagnosis. According to some of the research used on this project, approximately 38% of dissections are missed and possibly up to 50% are initially diagnosed as some other condition and not correctly identified until autopsy. Aortic dissections are two to three times more common than abdominal aortic aneurysm ruptures and, that being said, are still relatively uncommon.

Aortic dissections are classified in two common ways:

Debakey

Debakey Type I: begin at the ascending aorta and extend through the aortic arch to the descending aorta—these are the most lethal classification and are the most common in patients who present and are less than 65 years of age.

Debakey Type II: involve the ascending aorta.

Debakey Type III: involve the descending aorta only and may be classified further as IIIa: above the diaphragm and IIIb: extending below the diaphragm.

Stanford Classification

Type A: Involve ascending and descending aorta—these have a higher mortality rate with rates sited as approximately 75% within two weeks of diagnosis if left untreated. The majority of these patients present with severe chest pain.

Type B: Involve the descending aorta only and patients are most likely to have back pain and have a 50% chance of death within the first 48 hours without treatment.

Once a dissection is classified, our nursing care and assessments can be tailored specifically. For example, a patient with a Debakey Type II dissection would be assessed and reassessed for developing cardiac tamponade, or with a Type III, would be observed for

decreased urinary output or sensation/movement of lower limbs if the dissection is extending distally down the aorta.

The type of classification used is less important than the accuracy of the assessment, so that you know if the dissection involves ascending or descending aorta and, with that, know what nursing interventions may be required and what management strategies should be used for best patient care. Unfortunately, in emergency, the "classification" is not usually known prior to deterioration of the patient, so it is of not much use to us.

Risk factors for the development of aortic dissections, aneurysms and ruptures are the same for all. Hypertension and a smoking history are the primary factors. Other factors include: atherosclerosis, hyperlipidemia, genetic disorders (Marfan's syndrome, Ehlers Danlos Syndrome and other connective tissue disorders), stimulant use (cocaine, meth) family history of AAA, trauma with sudden deceleration, cardiac surgeries, cardiac catheterization, pregnancy (increases the risk x 3) arteritis, syphilis, TB and more.

Aortic "disease" is three times more common in men, more common in black people than white people, and 75% of presenting patients are between 40 and 75 years—with the majority over 60 years of age. Women have worse outcomes than men, and this is most likely due to the fact that they are frequently misdiagnosed or the diagnosis is delayed. Aortic dissection should be considered a differential diagnosis in any pregnant woman with complaints of chest pain and shortness of breath.

Timely diagnosis of aortic conditions is challenging because of the variety of presentations, and the mimicking of other conditions. The clinical symptoms and presentations depend on which area of the aorta is affected. This, in turn, can confuse the clinician, delaying not only the diagnosis, but also the appropriate treatment. These patients can present with any variety of symptoms, including undifferentiated shock and cardiac arrest.

The classic triad of symptoms: abdominal pain, hypotension and pulsatile abdominal mass is only present in 25% to 50% of patients. A "swooshing" or bruit may be heard over the abdominal aorta. Our patients may present with symptoms consistent with MI (more specifically an inferior MI, as the majority of dissections and aneurysms tend to be on the right side of the aorta and may occlude the right coronary artery). They may present with congestive heart failure symptoms—shortness of breath, stroke, pulmonary embolism, right pleural effusion renal colic or cholecystitis. Symptoms could be consistent with diverticular complaints, or neurological complaints or deficits. Differentiating dissection from Acute Coronary Syndrome and MI are extremely important, as anticoagulation and or cardiac catheterization for dissecting patients could prove to be lethal. Common misdiagnoses include: ACS, musculoskeletal pain, pneumonia, pericarditis, and GI pain, to name but a few. Patients with retroperitoneal ruptures may present with bruising to flank, scrotum, or perineum. Typically, our patients present with sudden onset of chest and/or abdominal pain, which may or may not radiate through to their back. They may or may not have differing BPs in each arm, with 20 mmHg or more being significant. This, too, will be reflective in pulse deficits. Realistically, this can only be found roughly 30% of the time. Twenty per cent of the population has significant differences in right and left BP with the dominant arm having higher BP. There are NO laboratory studies that are definitive in the diagnosis of aortic disease, though multiple studies reviewed show an elevated D-Dimer of greater than 500 μg/dl in patients with aortic dissection (this is not an opinion that is supported or endorsed by the vascular surgeons with whom I spoke while researching this presentation).

Diagnostic tests are based usually on the patient's presentation in emergency.

CT scans are the preferred radiological exam with greater than 90% accuracy, though the CT does not show the degree of involvement of the branch vessels.

Chest x-rays in patients with cardiac or respiratory symptoms generally (50%) will show a mediastinal widening with a dissection. For this reason, it must be done in patients with MI diagnoses prior to thrombolytic therapy. This said, the absence of mediasinal widening does not rule out a dissection of the aorta.

Transesophogeal echocardiography (TEE) is useful if the patient is hemodynamically unstable, and cannot be moved. It has the sensitivity of up to 100% in diagnosing a high dissection with an intimal flap, aortic regurgitation or extension of dissection into the coronary arteries Type A dissections. The disadvantage with this is that it must be done by someone with the skills to perform TEE.

Ultrasound, especially done at the bedside in the ER, is very helpful for diagnosis of rupture in showing blood in the abdomen.

MRI is more sensitive than CT scans, but impractical in the ER setting, as they are much more time consuming and the patient is inaccessible.

In emergency, we will see patients with symptoms produced by acute dissections or aneurysm ruptures, and these can be acute or chronic. "Chronic" is diagnosed when symptoms are ongoing for two or more weeks. Chronic dissections may be stabilized with medical therapies and then may become acute, as the dissection progresses or extends, and this may be what brings the patient into emergency. History taking is vitally important with any abdominal or chest pains, especially if the patient is older than 60 years of age, has hypertension and other risk factors, such as a history of smoking—even if they quit "years ago".

Elective repairs of aortic aneurysms are done based on the size and location. For Stanford Type A, surgery is indicated for sizes of 5 cm or greater and for Stanford Type B for sizes of 6 cm or greater. For a presentation of an "acute" nature in a patient with a Stanford A dissection, surgery is highly recommended, as ruptures of this type have an extremely high mortality rate.

Medical management before surgical repair on an elective basis is aimed at decreasing the blood pressure and lowering the heart rate with beta blockers (Esmolol, Labetalol). This is the first-line therapy for emergency patients where aortic dissection is suspected. Beta blockers decrease the left ventricular contractile force and will decrease the pressure through the false lumen between the aorta wall layers.

If our patients present with an aortic dissection and hypertension, research recommends the use of a Nitroprusside drip with beta blockers, and that it is titrated to lower and maintain the systolic blood pressure at 100 to 120 mmHg with a target heart rate of 60 beats per minute. Beta blockade is to be achieved before the Nitroprusside drip is started to decrease the likelihood of reflex tachycardia, which could occur if they aren't started first. Calcium Channel blockers can be used if, for whatever reason, beta blockers are contraindicated. Pain should be controlled with titratable opioids (i.e., morphine), which will also decrease the sympathetic tone.

Early and aggressive attention to hemodynamic stability in the emergency department can give patients with acute aortic dissection or aneurysm rupture the best possible chance for successful surgical intervention.

With aortic aneurysm ruptures, risk factors are the same as with aortic dissections. Thoracic aortic aneurysms are less common with 80% of the ruptures of the aorta occurring below the level of the renal arteries.

Initial ER assessment and treatment is again focused on hemodynamic stabilization, but with ruptures the patient will most often present with hypotension, which may be profound.

Resuscitative efforts focus on A, B, Cs, at least two large bore IVs with infusion of crystalloids and blood products, with transfer to the operating room as soon as possible for surgical repair either done endovascularly or open abdominal approach. Preoperatively, patients need the usual ICU blood work, ECG, CXR, Foley, N/G, arterial line, and CVP line, all of which can be done in the OR if time is of the essence. The aim in the resuscitative efforts is to improve/maintain end organ perfusion prior to and during surgery, as opposed to a "target" blood pressure. **It is important to keep in mind that fluid overload could result in compromising the patient by disruption of the clotting cascade or dislodgement of a clot.**

In emergency, with patients who have abdominal pain and fit the risk factors for potential aortic "disease", ALWAYS suspect the worst. Perform serial assessments and evaluations of their condition. Be extremely vigilant with elderly women who have these symptoms and risk factors—these patients are often under-diagnosed and under-treated. Women often are vague and underplay the severity of their complaints, as with MIs.

Acute abdominal pains with abnormal vital signs should be a CTAS 2 and, ideally, have physician assessment within 15 minutes. This said, hypotension can be an ominous sign, as well as extreme hypertension. Errors with diagnosis may occur in upwards of 60% of aortic aneurysm and aortic dissection patients.

Dr. H. Cox from the Grey Nuns Edmonton recommends that any patient with hypertension that is not controlled with medication should be screened with a CT scan (elective) for an aortic aneurysm.

The classic triad for AAA is: abdominal pain, pulsatile abdominal mass, and hypotension. Remember though, that less than 50% of patients have the pulsatile mass and that hypotension is a late sign and is a sign that could indicate poor prognosis.

On a side note, studies done in Charlotte, NC, and published in the *American Journal of Emergency Medicine* (Pierce & Courtney, 2008) found PEA to be the most prevalent cardiac arrest rhythm in patients with ruptured AAA. The article suggested that patients presenting in ER with PEA arrest, with a suspected aortic dissection, may benefit from an emergency pericardiocentesis to relieve a cardiac tamponade that may have resulted from an ascending aorta dissection. This said, a true acute aortic dissection is instantly fatal in the pre-hospital setting.

Case presentations

- 48-year-old male to ER with altered mental status and seizure, right neck pain, left hemiparesis and ST depression proceeds to have Vfib arrest—resuscitation is not successful. COD determined to be hemopericardium and right carotid artery dissection.
- 62-year-old female to ER with abdominal pain, altered mental status, syncope and ECG showing ST depression and then ST elevation. Proceeded to have Vfib arrest. COD determined to be aortic dissection to coronary arteries and hemopericardium.
- 48-year-old female to ER with headache and seizure, had Vfib arrest in ER. COD aortic dissection. She had no complaints of chest or abdominal pain, only neurological symptoms.
- 45 patient charts were reviewed from GNH ER… 75% of patients had history of smoking and 12/45 female, 4/45 under 60 years and all were female. Many of these patients presented with back pain, but only two reviewed had pain described as "ripping".
- 63-year-old male: non-smoker Hx ^cholest ^BP presented with cardiac-type chest pain, sent to GNH for CT to R/O PE and was Dx with AAA. At the rural site, had been worked up for cardiac with enzymes, ECG CXR, Nitro and Lovenox… o/a remained with ^BP 158/90R & 167/80 L (patient had discontinued own antihypertensives three weeks prior to ER). Was eventually diagnosed with Type B aortic dissection, spent four days in ICU on Labetalol and Nitroprusside and then was discharged home after 10 days with oral antihypertensives.
- 74 year-old male: sent to ER for back pain (sent by chiropractor), investigations shown to have AAA.... was discharged home and readmitted two weeks later for elective EVAR of 5.9 cm infrarenal AAA.
- 67-year-old male: into ER with c/o general weakness, numbness to legs that began approx 1.5 hours before he presented to ER (2000hr). He was able to move all his limbs and did have abdo and shoulder pain. Hx ^BP. The next morning CT showed dissecting aortic aneurysm from RCA to RT femoral artery with blood in pericardium, but no tamponade though a small rt hemothorax. He was transferred out to the U. of A., but the outcome was POOR.
- 68-year-old male: had sudden onset of rt flank and back pain and collapsed in WR after a one-hour wait for a room—was triaged as renal colic-type pain (3). Once in ER was seen to be mottled from the waist down with weak femoral pulse… had a STAT CT and was to the OR in less than 45 minutes… diagnosed with Juxtarenal AAA rupture... discharged home after 12-day hospitalization… did have ^BP and hx of smoking.
- 29-year-old female: EMS to ER with chest pain radiating to neck, jaw and arm approximately 1000 hour. Pain described

as 10/10 squeezing, there was no SOB, no diaphoresis, BP left 136/79 rt 108/74 CXR done, then CT were non-diagnostic of PE so augmented CT done at 1545. This showed ascending aortal dissection from root of aorta upwards. Patient was started on Labetalol to lower BP and was transferred STAT to U. of A. at 1630 where the dissection was repaired and the patient did well post operatively.

- 32-year-old male: CTAS 2 presented with chronic back pain for five to six years with increased intensity for a "few days". He was sent for L-S spine x-rays by chiropractor and then on to ER for suspicion of AAA. The back pain was lower back to right lower quadrant and down the anterior thigh. He had no abdominal pain. With further history he had a positive family history of AAA (dad and two paternal aunts). He was a non-smoker, but had significant HTN and was noncompliant with medication. No other medical history. With abdominal palpation he was found to have a pulsatile mass. CT revealed a 7.4 cm infrarenal AAA which he had elective surgical repair for three days after his ER presentation. He did well and was discharged from hospital five days post-op.
- 33-year-old male (Chinese heritage): presented to the tertiary centre with 26-hour history of chest/epigastric/back pain with hematuria. He was sent to the ER with suspected renal colic by the GP. In ER he had a lot of pain and systolic BP of 230. He had a syncopal episode in the ER waiting room and had a seizure. He was then sent for CT of the head and chest. Diagnosis was made of Type A dissection. His BP was stabilized with Labetalol ad he was sent to the "vascular" centre. BP was now 130/68 and his hgb was found to have dropped from 158 to 114. His prior history was HTN noncompliant with medication and smoking. An augmented CT was done and showed a dissection that extended down the descending aorta (T5 down to the common iliac arteries) and also a large right-sided hemothorax. Prior to surgery he had pedal pulses, which were palpable on the left and not on the right (even with Doppler). Right femoral pulse was only obtainable with a Doppler. This patient was sent STAT to the OR for thoracic EVAR repair. The next morning in ICU he was found to have no movement or sensation below T6 and was diagnosed with paraplegia secondary to ischemia of the Artery of Adamkewicz. He was discharged to a rehabilitation facility and the case is now in litigation, so further information is not available.

I hope this presentation has been useful in reminding us of the importance of our nursing assessments and having a high index of suspicion, and remembering that depending on the location of the dissection or rupture, symptoms can vary greatly. Timely diagnosis and maintaining end-organ perfusion are of utmost importance for our patients with aortic disease, be it dissection or rupture.

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