

## **Survivors of Aortic Dissection: Activity, Mental Health, and Sexual Function**

**Ashish Chaddha<sup>1</sup> BS, Eva Kline-Rogers<sup>1</sup> MS, RN, NP, Alan C. Braverman<sup>2</sup> MD, Steven R. Erickson<sup>1</sup> PharmD, Elise M. Woznicki<sup>1</sup> BS, Justin T. Jabara,<sup>1</sup> Daniel G Montgomery<sup>1</sup> MS, and Kim A. Eagle<sup>1</sup> MD**

<sup>1</sup>Cardiovascular Center, University of Michigan, Ann Arbor, Michigan, USA

<sup>2</sup>Cardiovascular Division, Washington University, St. Louis, Missouri, USA

Correspondence:

Ashish Chaddha

University of Michigan Cardiovascular Center

6665 Crabapple Court

Troy, MI 48098

Phone: 586.703.6781

Fax: 734.998.9939

Email: achaddha@uwhealth.org

Word Count: 4,400

Subject Codes: [26] exercise, [14] other hypertension, [122] secondary prevention

Brief Observations

### **Abbreviations:**

AAD: acute aortic dissection, SBP: systolic blood pressure, DBP: diastolic blood pressure

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1002/clc.22418](https://doi.org/10.1002/clc.22418)

MABP: mean arterial blood pressure, BP: blood pressure

\*\*No disclosures or sources of funding.

## ABSTRACT

**BACKGROUND:** Currently there is no research assessing the lifestyle modifications and emotional state of aortic dissection survivors after discharge. Exercise recommendations are also lacking for this patient cohort. The goal of this study was to better understand the physical activity preferences of aortic dissection survivors before and after aortic dissection, the influence of functional status on physical activity, and to offer recommendations for likely safe and beneficial aerobic activity. In addition, we sought to assess exercise goals, the association between physical and/or emotional exertion and aortic dissection onset, impact on occupation, lifestyle and consequent activity restriction and hobbies, desire for specific activity recommendations, incidence of depression and anxiety and its association with consistent aerobic exercise, and the impact on sexual activity.

**METHODS:** A cross sectional survey was mailed to 197 subjects from a single academic medical center which is a part of the larger IRAD database. Subjects who were at least 18 years of age and survived a type A or type B AAD between 1996 and 2011 were included. 82 completed surveys were returned (overall response rate 42%).

**RESULTS:** Mean age  $\pm$  SD was  $59.5 \pm 13.7$  years, with 54.9% type A patients and 43.9% type B patients. A majority of patients engaged in walking before and after aortic dissection, 49 (60%) and 47 (57%), respectively. The number of patients who did not engage in any physical activity

increased from 14 (17%) before aortic dissection to 20 (24%) after dissection. A minimal number of patients took part in weightlifting prior to aortic dissection, and this diminished after aortic dissection (12 (14%) and 7 (8%), respectively). Most patients (66.7%) were not exerting themselves physically or experiencing intense emotions at AAD onset. Systolic blood pressure (SBP) at 36 months post-discharge for patients who engaged in  $\geq 2$  sessions of aerobic activity/week (defined as “consistent” aerobic activity) was  $126.67 \pm 10.30$  vs.  $141.10 \pm 11.87$  (p-value 0.012) in those who did not. Self-reported emotional well-being after AAD revealed 32% with new-onset depression and 32% with new-onset anxiety. Of the 54 (66%) patients who performed exercise consistently, 13 (24%) reported new-onset depression. Conversely, 50% of the 26 patients who did not consistently engage in exercise reported new-onset depression (p-value 0.020).

**CONCLUSION:** Alterations in lifestyle and emotional state are frequent in survivors of AAD. Following AAD, physical inactivity increased most likely due to fear; functional status was mostly intact. This is unhealthy as consistent low-intensity aerobic exercise promotes mental and physical well-being. Our subjects who engaged in consistent low intensity aerobic activity had a lower resting blood pressure. Thus, walking or other forms of mild aerobic activity should be encouraged, as the most common exercise goal for patients was improved cardiovascular health. In addition, physical and emotional stress may not play as large a role in triggering aortic dissection in patients with no prior history of aortic aneurysm compared to those with a prior history of aortic aneurysm. Many patients post-dissection were unable to return to their prior occupation. The majority of patients wished there were specific recommendations regarding

which activities are likely safe and which may not be safe after dissection, pointing toward a better need for post-procedure patient education and further research developing specific activity guidelines for this patient cohort. Post-dissection depression and anxiety are common and should be screened for and treated. These findings suggest that cardiac rehabilitation would likely be beneficial in this patient cohort. Patients also avoided sexual activity after AAD. Health care providers should screen for and allay this unfounded fear. In general, clinicians should screen for unfounded fears or beliefs after dissection that may reduce function and/or quality of life for aortic dissection survivors.

## **Introduction**

Aortic dissection is a life-threatening emergency that involves a tear in the intimal wall. Studies have shown good long-term survival after initial treatment<sup>1</sup>. However, currently there is no research assessing the lifestyle modifications and emotional state of aortic dissection survivors after discharge. Exercise recommendations are also lacking for this patient cohort. The goal of this study was to better understand the physical activity preferences of aortic dissection survivors before and after aortic dissection, the influence of functional status on physical activity, and to offer recommendations for likely safe and beneficial aerobic activity. In addition, we sought to assess exercise goals, the association between physical and/or emotional exertion and aortic dissection onset (unclear association at the moment)<sup>2-4</sup>, impact on occupation, lifestyle and consequent activity restriction and hobbies, desire for specific activity recommendations,

incidence of depression and anxiety and its association with consistent aerobic exercise, and the impact on sexual activity.

## **Materials and Methods**

### **Study Design**

This was a cross sectional survey of patients from a single-center, coupled with retrospective data obtained from the center's aortic dissection registry. T

### **Study Population**

The sample of patients used for this study was derived from the single health system's aortic dissection registry, which is a site for the International Registry of Acute Aortic Dissection (IRAD), a multinational registry consisting of 34 referral centers in 12 countries.

Comprehensive details regarding IRAD have been previously published<sup>5,6</sup>.

Our subjects included only those from a single IRAD site. These patients experienced their aortic dissection between 1996 and 2011. Patients were those with acute Type A or Type B aortic dissection (AAD). Type A AAD was defined as any non-traumatic dissection involving the ascending aorta and presenting within 14 days of symptom onset. Type B acute aortic dissection was defined as any non-traumatic dissection involving the descending aorta and presenting within 14 days of symptom onset.

All subjects age 18 years and older who survived to discharge were considered for the study cohort. Subjects were excluded if their mailing address on record was incorrect or if they were deceased.

### **Data and Collection Procedure**

Of the total patients registered in IRAD at this single academic center (326), 91 patients were deceased based on the Social Security Death Index up until June, 2013 (n=91, mean age  $71.40 \pm 12.88$ ). Of these patients, accurate mailing information was only available for 197 patients. Thus, the survey was sent to 197 patients and 82 surveys were returned as completed (response rate of 42%).

The survey was designed to obtain data on: physical activity preferences of patients before and after AAD, patient goals for exercise, effects of consistent low-intensity aerobic exercise on resting blood pressure, physical/emotional exertion during symptom onset, occupation/occupational changes, effects of aortic dissection on lifestyle, patients' desire for specific activity recommendations, independence with ADLs, presence of depression and/or anxiety, and frequency of sexual activity before AAD (defined as in the last eight weeks leading up to AAD) and after AAD (defined as in the last eight weeks leading up to receiving this survey) and possible reasons for limitation. These items were developed by the researchers and are novel to our group (see Appendix for survey). Table 1 lists the relevant questions from various sections of the survey.

Data obtained from this academic center's local IRAD registry included patient demographics, presenting symptoms and blood pressure, conditions associated with aortic dissection, dissection type and management, and aortic imaging information. Blood pressure for each patient was obtained from the retrospective chart review for clinic visits at 1, 3, 6, and 12 months after discharge, and annually until five years after discharge or the patient was lost to follow-up. This was the blood pressure value obtained at the clinic visit with either a cardiologist, cardiothoracic surgeon, or vascular surgeon. Aortic diameter was obtained from the CT imaging report. In cases where multiple imaging modalities were used to assess the aorta, such as CT, MRI, and TEE, only the diameters recorded by CT were used.

Frequencies with percentage or mean with standard deviation were determined for the respective variables. Pearson chi-square and Fisher's exact test were used to assess the association between consistent physical activity and resting blood pressure, as well as consistent physical activity and new-onset, self-reported, anxiety and/or depression.

## **Results**

### Study Population and Baseline Characteristics

Table 2 offers baseline characteristics of the study cohort for this analysis (n=82). Twenty-five (30.5%) patients were female. Forty-five (55%) patients had a type A AAD while 36 (43.9%) patients had a type B AAD. Forty-three (52.4%) patients were managed surgically. This survey was completed by patients at a median (Q1, Q3) of 7.1 years (5.6, 11.5) after discharge.

## Physical Activity Before and After Dissection

Figure 1 summarizes the study cohort in terms of various physical activity preferences before and after aortic dissection. A majority of patients engaged in walking before and after aortic dissection, 49 (60%) and 47 (57%), respectively. The number of patients who did not engage in any physical activity increased from 14 (17%) before aortic dissection to 20 (24%) after dissection. A minimal number of patients took part in weightlifting prior to aortic dissection, and this diminished after aortic dissection (12 (14%) and 7 (8%), respectively). Table 3 describes patient goals for exercise.

Eight (10%) patients require functional assistance, with five (6%) receiving assistance from their spouse and/or family member, one (1%) residing in an assisted living facility, and one (1%) requiring a home nurse.

## Aerobic Exercise and Resting Blood Pressure

The SBP (in mmHg) at 36 months after discharge for patients who engaged in at least two sessions of aerobic activity per week (defined as “consistent aerobic activity” per author consensus) was  $126.67 \pm 10.30$  compared to  $141.10 \pm 11.87$  for patients who did not engage in consistent aerobic activity (p-value 0.012). The difference in DBP at 36 months between the two groups was not statistically significant. There was no significant difference in resting blood pressure for patients who engaged in consistent low-intensity aerobic activity compared to those who did not at any of the other follow-up time points. The overall exercise goals of our patient



population are presented in table 3. The most common goals included desire to live longer and improved cardiovascular health.

#### Activity during Dissection Onset

Table 4 summarizes self-reported physical and/or emotional stressors at symptom onset. Two patients reported weightlifting, seven patients reported lifting heavy objects, six patients engaged in strenuous aerobic exertion, and eight patients described an intense emotional state or emotional trigger. Thus, a total of 23 (28%) patients reported physical exertion or intense emotions at symptom onset. Not every patient filled out this section of the survey.

The median (Q1, Q3) aortic diameter for type A AAD at onset with physical or emotional stress was 4.9 cm (4.0, 5.8), and was 5.1 cm (4.2, 5.9) at onset without physical or emotional stress (p-value .942). The median (Q1, Q3) aortic diameter for type B AAD at onset with physical or emotional stress was 4.3cm (3.7, 5.0), compared to 4.0cm (3.5, 4.2) at onset without physical or emotional stress (p-value .140).

#### Occupation

A total of 31 (38%) patients reported that their occupation prior to aortic dissection involved consistently lifting objects weighing >20 pounds. After aortic dissection, of these 31 patients, only one (3%) patient still performed the same job requiring the same physical intensity. Eleven (35%) patients changed to jobs consisting of less lifting or no lifting at all, 12 (39%)

patients are disabled due to their aortic dissection and thus no longer work. Seven (23%) patients have retired, as a result of their AAD.

#### Other Effects of Dissection on Lifestyle

62 (76%) patients believe that aortic dissection has negatively affected their life. Reasons include having to visit the doctor consistently, taking medications daily, no longer being able to do certain activities and exercise in the same way, fear of future aortic complications, limitations in sexual activity, and change of occupation or disability due to aortic dissection. Furthermore, when patients were asked which activities they were no longer allowed to perform after aortic dissection, as recommended by their aortic clinician, many patients reported not taking part in strenuous activity, snow shoveling, pushing/pulling/lifting >50 pounds, travelling and driving long distances, coughing strenuously, team sports, prior occupation, going on roller coasters, hunting and fishing, hang gliding and parachuting, and long-distance walking.

A total of 23 (28%) patients believe that surviving the aortic dissection has motivated them to exercise more, and 53 (65%) patients felt it motivated them to eat healthier. A majority, 51 (62%) patients, indicated a desire to take fewer medications, and 62 (76%) patients limit the amount of weight they lift, push, or pull since their dissection.

#### Communication with the Health Care Provider

A majority, 65 (79%) patients, indicated that their physician had a discussion regarding exercise and physical activity with them, while 57 (70%) of the total patients felt that their doctor

was clear in what exercises they should and should not perform. However, 58 (71%) patients still wished that there were specific recommendations about which activities are likely safe and which may not be safe in post-aortic dissection patients.

#### Depression, Anxiety, and Aerobic Exercise

26 (32%) patients self-reported depression due to their aortic dissection. Twenty-six (32%) patients also self-reported anxiety due to their aortic dissection. Of these 52 patients, 19 patients self-reported both new-onset depression and anxiety after dissection. Of the 26 (32%) patients who did not consistently engage in exercise (<2 sessions per week), 13 (50%) reported new-onset depression (p-value 0.020). Of the 54 (66%) patients who performed exercise consistently, 13 (24%) reported new-onset depression. No association was found between aerobic exercise and anxiety. Nine out of 24 patients managed medically self-reported new-onset depression after treatment, and 11 out of 31 patients managed surgically self-reported new-onset depression after treatment (p-value 0.336).

#### Sexual Activity

Prior to aortic dissection, 31 (38%) patients engaged in sexual activity. After aortic dissection, 9 (11%) patients reported sexual activity (figure 1). Twenty-seven (33%) patients feel their diagnosis limits their current sexual activity. Eleven (13%) patients express fear of adverse aortic events resulting from sexual activity, 12 (15%) patients feel a lack of libido, and 16 (20%) patients suffer from erectile dysfunction.

## Discussion

There is no information available about activity levels, lifestyle changes, quality of life, and mood disorders in survivors of AAD. Our survey of aortic dissection survivors illustrated an increase in physical inactivity after dissection. While we did not specifically ask why this may be the case, our clinical experience suggests it is likely in part due to fear. It is less likely due to impaired functionality as most of our patients indicated adequate functional status, with only 1% of patients requiring a home nurse after aortic dissection. Nevertheless, this increase in physical inactivity is most likely detrimental to overall health, resting blood pressure, and mental well-being. Mild aerobic activity has been shown to promote mental and physical health and lower resting blood pressure<sup>7</sup>. Our subjects who engaged in consistent mild aerobic activity had a lower resting blood pressure. Thus, clinicians should encourage aortic dissection survivors to consistently engage in mild to moderate aerobic exercise (3-5 METs) such as walking or other forms of aerobic activity (i.e. golf, low level bicycling, and other forms of mild aerobic cardiovascular activity).

The majority of our patients described their goals for exercise as living healthier and longer. It is plausible that strenuous exertion may be detrimental to the health of aortic dissection survivors, as the acute increase in blood pressure in the context of a weakened aortic wall may promote further aortic complications, which is suggested by the Law of LaPlace. However, to achieve these patient stated goals, strenuous exertion is not necessary. Studies have shown that consistent, low-intensity aerobic exercise is beneficial in lowering resting blood

pressure, which has been shown to lower mortality and improve outcomes in aortic dissection survivors. Our patients who reported consistent aerobic exercise also had a lower resting blood pressure. As a result, aortic dissection survivors should be asked about their exercise goals when formulating an exercise prescription, and should be encouraged to engage in consistent, low to moderate intensity aerobic activity (3-5 METs).

Previously, Hatzaras et al. identified 31 patients with a history of aortic aneurysm who suffered an aortic dissection in the context of intense physical exertion, predominantly weightlifting or lifting heavy objects<sup>2</sup>. Furthermore, in another study by Hatzaras et al., 60 out of 90 patients (66%) with prior aortic aneurysm reported strenuous physical exertion and/or intense emotions at acute aortic dissection symptom onset<sup>17</sup>. However, our results suggest that aortic size at type A and type B AAD onset is nearly equal among patients enduring physical and/or intense emotions compared to those not enduring physical and/or emotional stress at aortic dissection onset, and only 28% of our patients reported intense emotions or physical exertion at dissection onset. Thus, physical and emotional stress may not play as large a role in triggering aortic dissection in patients with no prior history of aortic aneurysm compared to those with a prior history of aortic aneurysm.

Over a third of patients reported consistently lifting greater than 20 pounds as a part of their occupation prior to aortic dissection. A similar frequency of patients also reported disability for work after aortic dissection. This, along with the likely prevalence of new-onset anxiety and/or depression after aortic dissection, suggests that cardiac rehabilitation after discharge may be beneficial. A study by Corone et al. showed that cardiac rehabilitation after

discharge, for patients experiencing a type A AAD, improved functionality, allowed patients to return to work earlier, increased muscular strength, and improved mental well-being<sup>16</sup>. In addition, patients expressed a desire for specific activity recommendations and felt that consequent activity restriction reduced their quality of life, suggesting a need for better patient education and further research to develop specific activity guidelines for this patient cohort.

The prevalence of mood disorders in the United States ranges from 5-10% in elderly patients<sup>9, 10</sup>. The prevalence of depression and anxiety in survivors of myocardial infarction is 17% to 37% and 24% to 31%, respectively<sup>11</sup>. Depression is prevalent in over 20% of heart failure patients<sup>12</sup>. Our results suggest that post-dissection self-reported depression and anxiety is common, and may be more prevalent than in survivors of other heart diseases. Thus, aortic specialists should screen patients for and treat anxiety and depression. Although currently no association has been established between mood disorders and outcomes in aortic dissection survivors, anxiety and depression have been associated with increased morbidity and mortality in survivors of myocardial infarction and heart failure<sup>13, 14</sup>. Furthermore, more than 50% of our patients who did not consistently perform physical activity reported new-onset depression after aortic dissection, suggesting a possible association between depression and decreased aerobic exercise. Since exercise may play an important role in the treatment of depression<sup>15</sup>, it may be especially important for aortic specialists to encourage mild aerobic exercise for aortic dissection survivors who suffer from depression.

Avoidance of sexual activity was also common post-dissection and is unnecessary<sup>8</sup>, with the most common reason reported being fear. Health care providers should evaluate sexual

health and allay this unfounded fear. While it is certainly possible that this could be due to social factors (i.e. impaired health of significant other, divorce, single status, etc.), our patients did not provide this as a reason for impaired sexual activity. Decreased sexual activity may contribute to decreased quality of life and consequent impaired mental health.

### **Limitations**

We acknowledge the presence of recall bias. It is certainly plausible that non-responders were either doing so well as to not respond, or are extremely debilitated and not able to respond or deceased since the time of mailing the survey. It is unclear which of these two groups the non-responders belong to. It is also possible that only healthy subjects responded to our survey. The response rate may have also been higher had this survey been given to patients during clinic follow-up visits rather than through mail. However, several of these patients received initial management at our academic medical institution but received follow-up care with their local cardiologist and did not return to our institution. In addition, we acknowledge that it is difficult for patients to remember as far back as 15 years and describe their lifestyle habits before aortic dissection, further contributing to recall bias. In addition, these data are also self-reported and unable to be independently verified, reducing external validity.

We are unable to account for the influence of cardiac rehabilitation on these outcomes, as some patients may have received cardiac rehabilitation while others may not have. Given cardiac rehabilitation has been shown to positively affect lifestyle, it is a topic for further study in aortic dissection survivors. Currently no data exists on the effects of cardiac rehabilitation on

outcomes in aortic dissection survivors.

No additional instructions were given to patients for filling out this survey besides those listed in the instructions in the survey (table 1). However, we did our best to make the survey as easily comprehensible as possible and also used large font, understanding that many of our patients are older and may have decreased vision. In returned surveys, our patients wrote how grateful they were that we had sent them this survey and wanted to study this topic further.

The survey utilized in this study is one developed solely by the researchers and has not been validated. The questions were developed based on the clinical experience of the researchers. It was felt that a better understanding of these topics would further improve patient care. In addition, we are unable to examine the influence of social support (married vs. single) on these outcomes of interest.

Ideas for future research include impact of social support on these outcomes, cognitive testing and IQ assessment for survivors treated medically versus surgically, and further screening for incidence of depression, suicidal rate/intension, anxiety, and quality of life.

## **Conclusions**

Alterations in lifestyle and emotional state are frequent in survivors of AAD. Following AAD, physical inactivity increased most likely due to fear; functional status was mostly intact. This is unhealthy as consistent low-intensity aerobic exercise promotes mental and physical well-being. Our subjects who engaged in consistent low intensity aerobic activity had a lower resting blood pressure. Thus, walking or other forms of mild aerobic activity should be encouraged, as



the most common exercise goal for patients was improved cardiovascular health. In addition, physical and emotional stress may not play as large a role in triggering aortic dissection in patients with no prior history of aortic aneurysm compared to those with a prior history of aortic aneurysm. Many patients post-dissection were unable to return to their prior occupation. The majority of patients wished there were specific recommendations regarding which activities are likely safe and which may not be safe after dissection, pointing toward a better need for post-procedure patient education and further research developing specific activity guidelines for this patient cohort. Post-dissection depression and anxiety are common and should be screened for and treated. These findings suggest that cardiac rehabilitation would likely be beneficial in this patient cohort. Patients also avoided sexual activity after AAD. Health care providers should screen for and allay this unfounded fear. In general, clinicians should screen for unfounded fears or beliefs after dissection that may reduce function and/or quality of life for aortic dissection survivors.

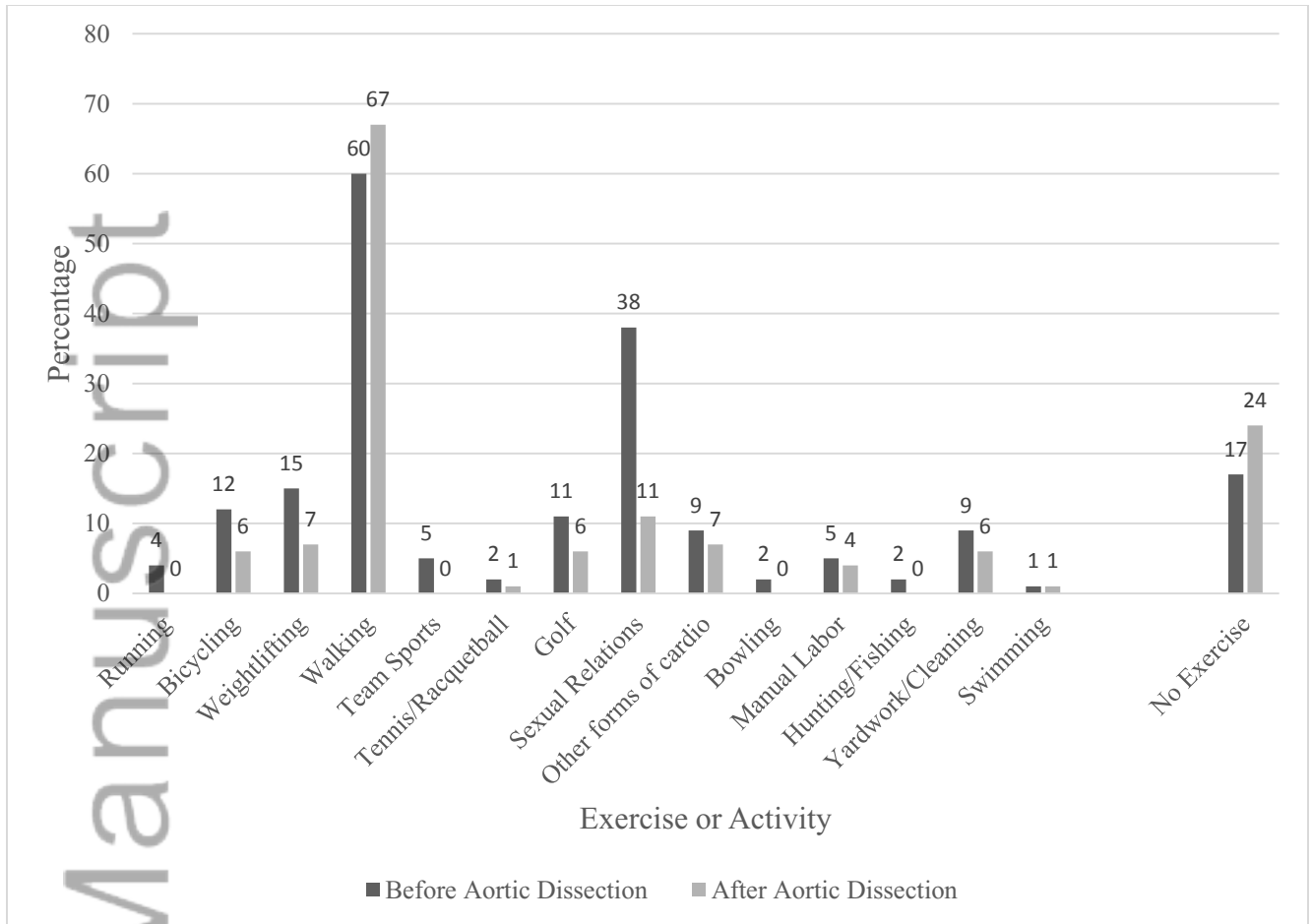
## References

1. Tsai TT, Fattori R, Trimarchi S, Isselbacher E, Myrmel T, Evangelista A, Hutchison S, Sechtem U, Cooper JV, Smith DE, Pape L, Froehlich J, Raghupathy A, Januzzi JL, Eagle KA, Nienaber CA, International Registry of Acute Aortic D. Long-term survival in patients presenting with type b acute aortic dissection: Insights from the international registry of acute aortic dissection. *Circulation*. 2006;114(21):2226-2231
2. Hatzaras I, Tranquilli M, Coady M, Barrett PM, Bible J, Elefteriades JA. Weight lifting and aortic dissection: More evidence for a connection. *Cardiology*. 2007;107(2):103-106
3. de Virgilio C, Nelson RJ, Milliken J, Snyder R, Chiang F, MacDonald WD, Robertson JM. Ascending aortic dissection in weight lifters with cystic medial degeneration. *The Ann Thorac Surg*. 1990;49(4):638-642
4. Hatzaras IS, Bible JE, Koullias GJ, Tranquilli M, Singh M, Elefteriades JA. Role of exertion or emotion as inciting events for acute aortic dissection. *Am J Cardiol*. 2007;100(9):1470-1472
5. Mehta RH, O'Gara PT, Bossone E, Nienaber CA, Myrmel T, Cooper JV, Smith DE, Armstrong WF, Isselbacher EM, Pape LA, Eagle KA, Gilon D, Dissecti IRAA. Acute type a aortic dissection in the elderly: Clinical characteristics, management, and outcomes in the current era. *J Am Coll Cardiol*. 2002;40(4):685-692
6. Hagan PG, Nienaber CA, Isselbacher EM, Bruckman D, Karavite DJ, Russman PL, Evangelista A, Fattori R, Suzuki T, Oh JK, Moore AG, Malouf JF, Pape LA, Gaca C, Sechtem U, Lenferink S, Deutsch HJ, Diedrichs H, Robles JMY, Llovet A, Gilon D, Das

- SK, Armstrong WF, Deeb GM, Eagle KA. The international registry of acute aortic dissection (irad) - new insights into an old disease. *JAMA*. 2000;283(7):897-903
7. Brook RD, Appel LJ, Rubenfire M, Ogedegbe G, Bisognano JD, Elliott WJ, Fuchs FD, Hughes JW, Lackland DT, Staffileno BA, Townsend RR, Rajagopalan S, American Heart Association Professional Education Committee of the Council for High Blood Pressure Research CoC, Stroke Nursing CoE, Prevention, Council on Nutrition PA. Beyond medications and diet: Alternative approaches to lowering blood pressure: A scientific statement from the american heart association. *Hypertension*. 2013;61(6):1360-1383.
8. Chaddha, A, Kline-Rogers EM, Woznicki EM, Brook R, Housholder-Hughes S, Braverman AC, Pitler L, Hirsch AT, Eagle KA. Activity recommendations for post-aortic dissection patients. *Circulation*. 2014; 130: e140-e142.
9. Weissman MM, Myers JK. Affective disorders in a us urban community: The use of research diagnostic criteria in an epidemiological survey. *Arch Gen Psychiatry*. 1978;35(11):1304-1311
10. Borson S, Barnes RA, Kukull WA, Okimoto JT, Veith RC, Inui TS, Carter W, Raskind MA. Symptomatic depression in elderly medical outpatients. I. Prevalence, demography, and health service utilization. *J Am Geriatr Soc*. 1986;34(5):341-347
11. Lane D, Carroll D, Lip GY. Anxiety, depression, and prognosis after myocardial infarction: Is there a causal association? *J Am Coll Cardiol*. 2003;42(10):1808-1810

12. Rutledge T, Reis VA, Linke SE, Greenberg BH, Mills PJ. Depression in heart failure a meta-analytic review of prevalence, intervention effects, and associations with clinical outcomes. *J Am Coll Cardiol*. 2006;48(8):1527-1537
13. Carney RM, Blumenthal JA, Stein PK, Watkins L, Catellier D, Berkman LF, Czajkowski SM, O'Connor C, Stone PH, Freedland KE. Depression, heart rate variability, and acute myocardial infarction. *Circulation*. 2001;104(17):2024-2028
14. Mayou RA, Gill D, Thompson DR, Day A, Hicks N, Volmink J, Neil A. Depression and anxiety as predictors of outcome after myocardial infarction. *Psychosom Med*. 2000;62(2):212-219
15. Babyak M, Blumenthal JA, Herman S, Khatri P, Doraiswamy M, Moore K, Craighead WE, Baldewicz TT, Krishnan KR. Exercise treatment for major depression: Maintenance of therapeutic benefit at 10 months. *Psychosom Med*. 2000;62(5):633-638
16. Corone S, Iliou MC, Pierre B, Feige JM, Odjinkem D, Farrokhi T, Bechraoui F, Hardy S, Meurin P, Cardiac Rehabilitation working Group of the French Society of Cardiology. French registry of cases of type i acute aortic dissection admitted to a cardiac rehabilitation center after surgery. *Eur J Cardiovasc Prev Rehabil*. 2009;16(1):91-95
17. Hatzaras IS, Bible JE, Koullias GJ, Tranquilli M, Singh M, Elefteriades JA. Role of exertion or emotion as inciting events for acute aortic dissection. *Am J Cardiol*. 2007;100(9):1470-1472

**Figure 1:** Percentage of Patients Engaging in Various Exercises and Activities Before and After Aortic Dissection and P-values



P-values for before vs. after: Running (0.250), bicycling (0.125), weightlifting (0.180), walking (0.839), team sports (0.125), tennis/racket sports (1.00), golf (.289), sexual relations (0.000), other forms of cardio (0.152), no exercise (0.263).

**Table 1:** Relevant Questions from the Lifestyle Survey

Section	Question(s)
Physical activity preferences before and after aortic dissection	<p>Indicate which activities you did consistently, 2 or more times per week selecting all that apply.</p> <p><input type="checkbox"/> Running      <input type="checkbox"/> Bicycling   <input type="checkbox"/> Weightlifting   <input type="checkbox"/> Walking   <input type="checkbox"/> Team sports</p> <p><input type="checkbox"/> Tennis/racket sports   <input type="checkbox"/> Golf   <input type="checkbox"/> Sexual relations   <input type="checkbox"/> Did not engage consistently in physical activity   <input type="checkbox"/> Other_____</p>
Exercise goals	<p>Please indicate which of the following exercise goals are the most important to you. You may mark more than one.</p> <p><input type="checkbox"/> I want to be able to run for a longer period of time</p> <p><input type="checkbox"/> I want bigger muscles      <input type="checkbox"/> I want to lose body fat</p> <p><input type="checkbox"/> I want to be stronger                      <input type="checkbox"/> I want to be a powerlifter</p> <p><input type="checkbox"/> I want to live longer                      <input type="checkbox"/> I want to be better at sports/team sports</p> <p><input type="checkbox"/> I want a lower resting blood pressure/heart rate</p> <p><input type="checkbox"/> I want to improve the health of my heart</p>
Activity during symptom onset	<p>Indicate which activities you were doing when you first experienced your symptoms related to the aortic dissection. Please circle one option and fill in the blank where applicable.</p> <ul style="list-style-type: none"><li>- Exercising: indicate activity:_____</li><li>- Weight lifting: how many pounds were you lifting and what muscle group(s) were you using? _____</li><li>- Emotional stress: select all that apply: i. arguing/intense anger      ii. I had just received bad news      iii. Other_____</li><li>- Forcefully coughing</li><li>- Lifting a heavy object: what were you lifting and how many pounds was it?</li></ul>

- sexual relations
- I was not doing any type of activity

Occupation Prior to my very first aortic dissection, my job consisted of lifting heavy objects on a consistent basis (lifting an object e 20 pounds at least two times per week)

Yes No

- If you answered yes, please circle all of the following choices that apply:
- My current job is just as physically intense as my job before my very first aortic dissection
- My current job is less physically intense
- I changed jobs because of my aortic dissection
- In my current job I never lift heavy objects
- I no longer work because I am retired
- I no longer work because of my aortic dissection

Functionality Do you currently need assistance with at least one of the following: eating, bathing, dressing, grooming, moving without assistance, using the toilet?

Yes No

If yes, please indicate who offers assistance (please circle all that apply)

Spouse

Other family member

Nurse

Other (please specify) \_\_\_\_\_

Depression, anxiety Has your aortic dissection caused you to become depressed?

Yes No

Has your aortic dissection caused you to become anxious? Yes No

If you answered yes to questions 45 and/or 46, do you require medications for depression and/or anxiety after the aortic dissection (that you did not require before the dissection occurred)?

Yes No



Sexual activity

Does your diagnosis of aortic dissection limit your current sexual activity?  
(please circle one)                      Yes   No

If yes, is this due to (please circle all that are applicable):

- fear
- lack of libido
- erectile dysfunction
- Other: \_\_\_\_\_

Effect of aortic dissection on life

Aortic dissection has affected my life in a negative way      Yes   No

If yes, please indicate how (circle all that apply):

- I have to go to the doctor
- I have to take medication(s)
- There are certain activities I can no longer do
- I am unable to exercise like I used to
- I have to exercise consistently now whereas before I did not have to
- I am afraid I will have problems with my aorta in the future
- I feel it is my fault that I had the aortic dissection to begin with
- I feel guilty about my aortic dissection
- My sexual activity is limited
- I have become disabled from my prior occupation due to the aortic dissection (please name the occupation): \_\_\_\_\_
- Other (please specify): \_\_\_\_\_

Activities no longer allowed to perform

Please write below any activities you can no longer do or your doctor says you are no longer allowed to do because of aortic dissection. If not applicable, please leave blank.

Author Manuscript

**Table 2:** Patient Demographics, Medical History, Dissection Type and Management in Patients Who Completed the Survey

Characteristic	Overall (n=82)
Patient age at presentation, Mean (SD), years	59.5 ± 13.7
Patient age completion of survey, Mean (SD), years	67.8 ± 13.7
Male sex	25 (30.5%)
Caucasian ethnicity (vs. other)	51 (62.2%)
Medical history	
Marfan Syndrome	6 (7.3%)
Hypertension	49 (59.8%)
Dissection type	
Type A	45 (54.9%)
Male sex	34 (75.6%)
Caucasian ethnicity (vs. other)	34 (79.1%)
Type B	36 (43.9%)
Male sex	22 (61.1%)
Caucasian ethnicity (vs. other)	30 (83.3%)
Dissection management	

Surgery	43 (52.4%)
Type A	39 (86%)
Type B	4 (9%)
Endovascular repair	9 (11.0%)
Type B	9 (100%)
Medical management	25 (30.5%)
Type A	2 (8%)
Type B	23 (92%)
Hybrid	3 (1.4%)
Type A	3 (100%)

---

Author Manuscript

**Table 3:** Patient Exercise Goals

Exercise Goal	
Live longer	57 (70%)
Improved heart health	51 (62%)
Be stronger	34 (41%)
Lower resting heart rate and blood pressure	32 (39%)
Increase stamina and run for a longer period of time	3 (4%)
Bigger muscles	3 (4%)
Lose Fat	41 (50%)

**Table 4:** Activity and Aortic Size for Patients Who Reported Physical and/or Emotional Exertion at Symptom Onset

Activity	Age at dissection onset	Gender	History of HTN	History of Marfan Syndrome	Family history of aortic disease	Type of dissection	Treatment	Aortic size (cm)
Lifting chalkboard (100 pounds)	64	M	yes	no	no	B	medical	
Arguing Forcefully	43	M	yes	no	no	B	endovascular	
coughing	73	M	yes	no	no	A	surgical	5.7
Lifting 50-100 pounds	60	F	yes	yes	no	B	medical	4
Weightlifting, 60 pounds pectoral	72	M	No	No	No	A	Surgical	
Golfing	82	M	no	no	no	B	medical	4.2
Running softball	41	M	no	no	no	A	surgical	

bases									
Lifting wall frames	43	M	yes	no	no	A	surgical	5.2	
Lifting a heavy object	53	F	yes	no	no	B	medical	3.7	
Riding carnival ride	62	F	no	no	no	B	medical	3.3	
Bad news	46	M	no	yes	no	B	endovascular	3.7	
Holiday stress	71	F	no	no	no	A	hybrid		
Deadlifting 310 pounds	81	M	yes	no	no	B	endovascular	4	
Arguing	59	F	yes	no	no	A	medical	4.4	
Holiday stress	59	F	no	no	no	A	surgical	6	
Exercise stationary bike	44	F	no	no	yes	A	surgical	6	
Exercise climbing hill	49	F	no	yes	no	B	medical	2.8	
Forcefully coughing	65	F	no	no	no	A	surgical	4.3	
Walking	62	M	yes	no	no	B	endovascular	4.1	
Walking while shopping	60	F	yes	no	no	A	surgical	5.3	
Lifting a car tire	65	M	yes	no	no	B	medical	5	
Acute anxiety	49	M	No	No	No	A	Surgical	3.3	
Lifting another man (weight 120 pounds)	26	F	yes	Yes	Yes (Marfan's)	A	Surgical	3.5	
Sexual relations	70	M	Yes	No	No	B	Surgical	3.5	
Emotional stress	74	F	No	No	No	A	Surgical and endovascular	5.1	
Emotional stress	54	M	Yes	No	No	A	Surgical		
Playing volleyball	49	M	Yes	No	No	A	surgical		
Walking up the stairs	74	F	Yes	No	No	B	medical	4.5	
Pushing lawn mower	56	M	Yes	No	No	A	surgical	4.1	
Forcefully coughing, running on	52	F	Yes	No	No	A	Medical	5.0	

treadmill, and  
later lifting 20  
pounds with  
arms, chest.

Bicycling	53	M	Yes	No	No	A	Surgical	6.2
-----------	----	---	-----	----	----	---	----------	-----

HTN: Hypertension

Author Manuscript

Section	Question(s)
Physical activity preferences before and after aortic dissection	<p>Indicate which activities you did consistently, 2 or more times per week, selecting all that apply.</p> <p><input type="checkbox"/> Running   <input type="checkbox"/> Bicycling   <input type="checkbox"/> Weightlifting   <input type="checkbox"/> Walking   <input type="checkbox"/> Team sports</p> <p><input type="checkbox"/> Tennis/racket sports   <input type="checkbox"/> Golf   <input type="checkbox"/> Sexual relations</p> <p><input type="checkbox"/> Did not engage consistently in physical activity</p> <p><input type="checkbox"/> Other _____</p>
Exercise goals	<p>Please indicate which of the following exercise goals are the most important to you. You may mark more than 1.</p> <p><input type="checkbox"/> I want to be able to run for a longer period of time</p> <p><input type="checkbox"/> I want bigger muscles</p> <p><input type="checkbox"/> I want to lose body fat</p> <p><input type="checkbox"/> I want to be stronger</p> <p><input type="checkbox"/> I want to be a powerlifter</p> <p><input type="checkbox"/> I want to live longer</p> <p><input type="checkbox"/> I want to be better at sports/team sports</p> <p><input type="checkbox"/> I want a lower resting blood pressure/heart rate</p> <p><input type="checkbox"/> I want to improve the health of my heart</p>
Activity during symptom onset	<p>Indicate which activities you were doing when you first experienced your symptoms related to the aortic dissection. Please circle one option and fill in the blank where applicable.</p> <ul style="list-style-type: none"> <li>— Exercising: indicate activity: _____</li> <li>— Weight lifting: how many pounds were you lifting and what muscle group(s) were you using? _____</li> <li>— Emotional stress: select all that apply: <ul style="list-style-type: none"> <li>— i. Arguing/intense anger</li> <li>— ii. I had just received bad news</li> <li>— iii. Other _____</li> </ul> </li> <li>— Forcefully coughing</li> <li>— Lifting a heavy object: what were you lifting and how many pounds was it?</li> <li>— Sexual relations</li> </ul>

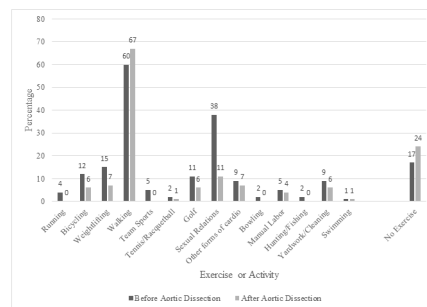


	<p>— I was not doing any type of activity</p>
Occupation	<p>Prior to my very first aortic dissection, my job consisted of lifting heavy objects on a consistent basis (lifting an object <math>\geq 20</math> pounds at least 2 times per week) Yes No</p> <p>If you answered yes, please circle all of the following choices that apply:</p> <ul style="list-style-type: none"> <li>— My current job is just as physically intense as my job before my very first aortic dissection</li> <li>— My current job is less physically intense</li> <li>— I changed jobs because of my aortic dissection</li> <li>— In my current job I never lift heavy objects</li> <li>— I no longer work because I am retired</li> <li>— I no longer work because of my aortic dissection</li> </ul>
Functionality	<p>Do you currently need assistance with at least 1 of the following: eating, bathing, dressing, grooming, moving without assistance, using the toilet? Yes No</p> <p>If yes, please indicate who offers assistance (please circle all that apply)</p> <ul style="list-style-type: none"> <li>— Spouse</li> <li>— Other family member</li> <li>— Nurse</li> <li>— Other (please specify) _____</li> </ul>
Depression, anxiety	<p>Has your aortic dissection caused you to become depressed? Yes No</p> <p>Has your aortic dissection caused you to become anxious? Yes No</p> <p>If you answered yes to questions 45 and/or 46, do you require medications for depression and/or anxiety after the aortic dissection (that you did not require before the dissection occurred)? Yes No</p>
Sexual activity	<p>Does your diagnosis of aortic dissection limit your current sexual activity? (Please circle one) Yes No</p> <p>If yes, is this due to (please circle all that are applicable):</p> <ul style="list-style-type: none"> <li>— Fear</li> <li>— Lack of libido</li> <li>— Erectile dysfunction</li> <li>— Other: _____</li> </ul>
Effect of aortic dissection on life	<p>Aortic dissection has affected my life in a negative way. Yes No</p>

<p style="text-align: center; font-size: 2em; opacity: 0.3; transform: rotate(-90deg);">Author Manuscript</p>	<p>If yes, please indicate how (circle all that apply):</p> <ul style="list-style-type: none"> <li>— I have to go to the doctor</li> <li>— I have to take medication(s)</li> <li>— There are certain activities I can no longer do</li> <li>— I am unable to exercise like I used to</li> <li>— I have to exercise consistently now whereas before I did not have to</li> <li>— I am afraid I will have problems with my aorta in the future</li> <li>— I feel it is my fault that I had the aortic dissection to begin with</li> <li>— I feel guilty about my aortic dissection</li> <li>— My sexual activity is limited</li> <li>— I have become disabled from my prior occupation due to the aortic dissection (please name the occupation):</li> </ul> <p style="margin-left: 40px;">_____</p> <ul style="list-style-type: none"> <li>— Other (please specify): _____</li> </ul>
<p>Activities no longer allowed to perform</p>	<p>Please write below any activities you can no longer do or your doctor says you are no longer allowed to do because of aortic dissection. If not applicable, please leave blank.</p>

Figure 1. Relevant questions from the Lifestyle Survey.

Author Manuscript



clc\_22418\_f2.tiff

## Supplemental Table: Demographics for Respondents for Selected Survey Questions

### Question/answer and patient characteristic (%)

#### Which of the following exercise goals are the most important to you- I want to live longer

(n=57), I want to improve the health of my heart (n=51)

Type A dissection: 29 (51%), 27 (53%)

Male: 20 (35%), 20 (39%)

Caucasian: 23 (40%), 18 (35%)

#### Physical activity of walking (pre-dissection n=60 , post-dissection n=67 )

Type A: 27 (45%), 28 (42%)

Gender: 20 (33%) , 20 (30%)

Caucasian: 20 (33%), 20 (30%)

#### Sexual relations (pre-dissection n=38, post-dissection n=11)

Type A: 15 (39%), 4 (36%)

Gender: 11 (29%), 3 (27%)

Caucasian: 11 (29%), 2 (18%)

#### Did not engage consistently in physical activity (pre-dissection n=17, post-dissection n=24)

Type A: 9 (53%) , 9 (38%)

Gender: 8 (47%), 7 (29%)

Caucasian: 8 (47%), 8 (33%)