Prevalence of abdominal aortic aneurysm and repair outcomes on the basis of patient sex: Should the timing of intervention be the same?

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The prevalence of abdominal aortic aneurysms (AAAs) has been reported to be higher in men than in women. Most prevalence studies (AAA diagnosed by means of autopsy, ultrasound screening, and hospital discharge data) demonstrated the percentage of AAAs diagnosed in women to be 19% to 34% and the percentage diagnosed in men to be 66% to 81%.¹⁻⁵ This rate appears to be reliably constant in many Western nations. No cause or causes for the dramatic difference in the prevalence of AAAs between the sexes has been identified.

Risk-factor profiles appear to be similar for both sexes. Age, cigarette smoking, and family history are all reported to have high association with AAA formation.^{5,6} Women are usually older than their male counterparts when they undergo AAA repair (Tables 1 and 2).^{1,6-12} Men have a higher association of ischemic coronary artery disease and peripheral aneurysms (usually femoral or popliteal in location), and women have a higher incidence of concomitant aortoiliac occlusive disease.⁶

The decision of when to recommend repair of an AAA for women is debatable. The general consensus is that the rupture rate increases with increasing aortic diameter. The rupture rate increases dramatically as the aneurysm diameter approaches 5 cm. Generally, when the aneurysm attains this size, treatment is recommended for low-risk patients in the United States. Similarly, a 5.5-cm aneurysm diameter is used for this standard in the United Kingdom. Data concerning the optimal timing of repair have been generated primarily in men. Measurement of AAA diameter, combined with close analysis of the individual patient's surgical risk, has been used historically to make operative recommendations. The optimal timing of repair on the basis of aortic diameters for women has not been clearly defined. The risk-benefit analysis might be different for women. The UK Small Aneurysm Trial demonstrated a 3-fold increase in the incidence of rupture of an AAA when controlling for aneurysm size in women compared with men.⁴ Therefore do normal aortas differ in size between men and women? A study designed to screen the size of abdominal aortas by using ultrasonography reported significant differences in normal aortic diameter between the sexes, as well as based on body mass indices and body surface area.¹³ In this study a total of 122,272 men and 3450 women were screened. Normal aortic diameter differed between men and women by 0.14 cm (women having the smaller aortic diameter).¹³ This finding is statistically significant, but the absolute size difference between men and women is small.

Several studies that examined hospital data (prevalence of AAAs and subsequent surgical treatment) suggested that women are offered surgical repair of AAAs at an alarmingly lower rate than their male counterparts.^{7,10,11} Unfortunately, these studies could not provide further data regarding the decision not to repair the AAA. Perhaps the women decided to forego therapy. Also possible is that their aneurysms were smaller than those of their male counterparts, making risk of rupture less likely and surgical repair less beneficial on the basis of the assumptions of size and rupture

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TABLE 1. Summary of perioperative mortality after elective abdominal aortic aneurysm repair by sex

Reference	Year of publication	Years data collected	Data source	Men	Mean age, men (y)	Women	Mean age, women (y)	Perioperative mortality, men	Perioperative mortality, women
Heller and colleagues ¹	2000	1979-1997	National Hospital Discharge Summary	277137 (77%)	73‡	81384 (23%)	70‡	5.1	7.7
Huber and colleagues ⁸	2001	1994-1996	Nationwide Inpatient Sample	13114 (80%)	71*	3340 (20%)	73*	3.7	6.1*
Dardik and colleagues ⁹	1999	1990-1995	Maryland Health Services Cost Review Commission	1821 (78%)	70†	514 (22%)	72*	3.2	4.5
Lawrence and colleagues ¹⁰	1999	1990-1994	National Hospital Discharge Summary	27454 (85%)	69‡	4913 (15%)	76‡	7.0	6.7
Katz and colleagues ^{7,12}	1994 + 1997	1980-1990	Michigan Inpatient database	6716 (82%)	69*	1469 (18%)	73*	6.8	10.7*
Johnston and colleagues ⁶	1994	1986	Canadian Society of Vascular Surgery Registry	545 (80%)	69*	134 (20%)	72*	4.4	5.2

* $P < .05$, comparing men and women.

†Mean age for total population. The mean age for men only was not reported.

‡ P value not given.

TABLE 2. Summary of perioperative mortality after ruptured abdominal aortic aneurysm repair by sex

Reference	Publication year	Years data collected	Data source	Men	Mean age, men (y)	Women	Mean age, women (y)	Perioperative mortality, men	Perioperative mortality, women
Heller and colleagues ¹	2000	1979-1997	National Hospital Discharge Summary	52507 (77%)	72‡	15244 (23%)	78‡	41.6	64.8*
Katz and colleagues ^{7,12}	1994 + 1997	1980-1990	Michigan Inpatient database	2719 (80%)	72*	682 (20%)	77*	47.4	61.6*
Johnston and colleagues ⁶	1994	1986	Canadian Society of Vascular Surgery Registry	126 (86%)	NR	20 (14%)	NR	49.2	55
Evans and colleagues ¹¹	2000	1983-1995	Lothian Surgical Audit	481 (82%)	72†‡	105 (18%)	74†‡	33	38

NR, Not reported.

* $P < .05$.

†Median age.

‡ P value not given.

risk for men. Most studies demonstrated that women with AAAs are significantly older than men with AAAs when undergoing repair (Tables 1 and 2).^{6-9,12} Women might become older while the treatment team waits for the aneurysm to reach an absolute size before considering repair. Increased age might also dissuade either the patient or treating physician from pursuing aneurysmectomy because advanced age has been shown in some studies to portend a worse outcome.^{1,8,9,12}

In-hospital mortality rates for elective AAA repair have been reported to be similar for men and women. A signifi-

cant number of large, population-based reports have been published and are summarized in Table 1. These studies again demonstrate the large difference of prevalence of AAAs in men when compared with those in women. Most studies found no difference in perioperative mortality between men and women^{1,6,9,10}; however, several studies did demonstrate statistically significant higher mortality in women.^{7,8,12}

Perioperative mortality after repair of a ruptured AAA is summarized in Table 2. Fewer studies examined the outcomes of ruptured AAA than elective AAA. The data from

these reports are contradictory in terms of higher mortality in women when compared with that in men while undergoing repair of a ruptured AAA. The women were significantly older than men who receive treatment for ruptured AAA. This difference is even greater than that reported for elective AAA repair. This fact might partially, or even fully, explain the difference in mortality because age is another independent risk factor for mortality.

Endovascular repair of AAA was first introduced in 1991.¹⁴ Large volumes of commercially produced devices became available in the United States in the mid-1990s. Two devices gained US Food and Drug Administration approval in 1999, one in 2002, and another in 2003. Several reports have been published that examine the differences between men and women who underwent endovascular repair. Unfortunately, some of these studies had extremely low numbers of women evaluated and treated. It is difficult to compare outcomes for all devices because these devices are designed in unique ways that might cause different outcomes on the basis of device or patient selection alone. In addition, several devices have had modifications over time, which also makes comparisons difficult. Reports of large series of endovascular AAA repair demonstrate 11% (1018 total patients)¹⁵ and 14% (703 total patients)¹⁶ of treated patients were women. This is an even lower rate than that reported in many open surgical series. Women might not be candidates for endovascular repair because of several anatomic features. These include small access vessels, which might make passage of these large devices complex or impossible, and short, wide, and angulated aortic necks, which might prevent successful exclusion of blood flow from into the aneurysm sac.¹⁷ Most series demonstrated that a significantly higher number of women were ineligible for endovascular repair because of anatomic concerns.¹⁷⁻¹⁹ Despite these issues, 2 reports demonstrated no significant difference in mortality or morbidity between men and women who underwent endovascular AAA exclusion.^{17,20} As the technologic aspects of endografts improve, which includes smaller device profiles and greater variability in neck sizes and attachment options, more women might become eligible for endograft placement.

AAA affects significantly fewer women than men in Western nations. Women receive diagnoses and are treated at a more advanced age than similarly affected men. Women might be offered surgical repair at a significantly lower rate than men. Whether women have greater mortalities after open AAA repair (both elective and emergency) remains unclear. Women have more challenging anatomies for endovascular AAA repair, thus frequently excluding them from this treatment modality.

Future challenges include 3 important issues.

1. A need for basic research exists that would explain the striking difference in the prevalence of AAAs between men and women. If a physiologic basis for the difference is defined, important information regarding all arterial disease might be better understood.
2. Clinical research needs to be continued to determine sex-appropriate guidelines for the optimal timing of AAA repair for women and to investigate why women appear to undergo AAA repair at a lower rate than men.
3. Further technologic development of endografts might address the difficult anatomy that appears to be more common in women and make this option more available to them.

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