Effect of ethnicity on access and device complications during endovascular aneurysm repair

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Introduction: **There are no published reports on the association between ethnicity and outcome after aortoiliac stent grafting to treat aneurismal disease. Because Hawaii is a state with an ethnically diverse population, we conducted a retrospective study to examine this potential association. We hypothesized that individuals of Asian ancestry may have higher complication rates after endovascular repair compared with non-Asians.**

Methods: **All endovascular devices placed to treat aneurysm disease from 1996 to 2003 were evaluated in two institutions. The association between ethnicity and access-related and device-related complications, both periprocedural and delayed, was examined with logistic regression analysis.**

Results: **Ninety-two aortoiliac endografts were placed during the study period, including 87 in patients with abdominal aortic aneurysms with or without iliac aneurysm disease, and five patients with isolated iliac artery aneurysms. Forty-four percent of patients were categorized as Asian, 39% as white, 16% as Pacific Islander, and 1% as African American. Access-related and device-related complications (ADRCs) occurred in 11 of 92 (12%) of these patients. The following parameters were significantly associated with ADRCs: Asian ethnicity ($P = .015$), age greater than 80 years ($P = .02$), and external iliac diameter smaller than 7.5 mm ($P = .01$). Asian patients were more likely to have experienced ADRCs than were non-Asian patients (odds ratio, 7.3; 95% confidence interval, 1.5-35.8; $P = .015$). Asians also had smaller external iliac artery diameters ($P = .0003$) and more tortuous iliac arteries ($P = .03$) compared with non-Asians. After adjusting for iliac artery diameter and tortuosity, the association between Asian ethnicity and ARDCs became nonsignificant ($P = .074$), which suggests that the association between race and complications may be at least in part due to small and tortuous iliac arteries. There was no association between age, gender, or ethnicity and postoperative detection of endoleak.**

Conclusion: **Our data indicate that individuals of Asian ancestry are far more likely to experience adverse access-related and device-related complications after aortoiliac stent grafting than are non-Asians. We found that this association is at least partly attributable to the smaller and more tortuous iliac arteries in persons of Asian ancestry. (J Vasc Surg 2004;40:24-9.)**

Endovascular aortic aneurysm repair (EVAR) has been used increasingly in many geographic areas of the world. Although factors such as gender[1] and age[2,3] affect outcome, little is known of the effect ethnicity may have on the results of stent grafting to treat aortic and iliac aneurysm disease. In Hawaii the racial diversity enables a unique opportunity to study whether differences in outcome exist between various ethnic groups.

Over 7 years we observed a higher rate of access- and device-related complications (ADRCs) in Asians compared with non-Asians. The purpose of this study was to test the hypothesis that a difference in outcome exists between races, and to determine the possible causes for this difference.

PATIENTS AND METHODS

From February 1996 to May 2003, 92 consecutive patients underwent endovascular stent-graft repair of aortic and iliac aneurysms; all but two of the procedures were performed since March 2000. This retrospective study was based on the collaborative effort of two institutions, Kaiser Permanente in Moanalua, Hawaii, and Straub Clinic & Hospital in Honolulu, Hawaii. Stent grafts used were the AneuRx (Medtronic/AVE; n = 75), Ancure (Guidant Corp; n = 10), Excluder (W. L. Gore & Associates; n = 5), and aortouniiliac device with balloon-expandable Z-stent, from Sweden (n = 2).

All patients underwent preoperative evaluation consisting of computed tomographic angiography and aortography with marker catheters. Preoperative measurements included aortic neck, common and external iliac diameters, and abdominal aortic aneurysm (AAA) diameter, and were determined with digital calipers on a PACS workstation. Aortic neck angulation (in degrees) was determined with a goniometer. Aortic thrombus, aortic calcification, iliac artery tortuosity, and calcification were graded as none, minimum, moderate, or severe. All devices were inserted in the operating room under C-arm fluoroscopic control and via bilateral groin incisions.

Ethnicity was analyzed between Asian and non-Asian groups. The Asian group included patients of Japanese, Chinese, Filipino, and Korean ancestry; the non-Asian group consisted of whites, Portugese, Pacific Islanders including Native Hawaiians, and blacks. Of note is that Native Hawaiians and Pacific Islanders are not considered

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directly descended from Asia, and are classified separately from Asians.

Cases were analyzed for preoperative risk factors, ethnicity, anatomic factors, and outcome, including periprocedural and delayed ADRCs. We included both minor and major complications in the analysis.

Statistical analysis. The association of study variables, particularly Asian ethnicity, with ADRCs was evaluated with logistic regression analysis. The effect of potential confounding factors on the relationship between Asian ethnicity and ADRCs was explored by evaluating logistic models containing Asian ethnicity alone and comparing them with models with added covariates. Mean iliac artery diameters were compared among Asians versus non-Asians with the Student *t* test.

RESULTS

Study population. The study population consisted of 92 patients, 72 men (78.3%) and 20 women. The male-female ratio was 4:1. Mean age of the population was 76.5 years (range, 50-90 years). Mean follow-up was 13.6 months (range, 1-84 months). In general, this was a high-risk group of patients, with advanced age and multiple medical comorbid conditions including clinical coronary heart disease (52%), chronic obstructive pulmonary disease (19%), history of cigarette smoking (71%), clinical cerebrovascular disease (14%), diabetes mellitus (23%), hypertension (79%), hyperlipidemia (54%), and history of abdominal surgery (36%). With regard to ethnicity, 44% of patients were categorized as Asian, 39% as white, 16% as Pacific Islander, and 1% (one patient) as African American.

As noted in Table I, Asian patients were more likely to be women ($P = .03$), more likely to have received treatment for hypertension ($P = .001$), and less likely to have a history of clinical cerebrovascular disease ($P = .03$).

Eighty-seven of the 92 patients (95%) had AAAs, with or without iliac artery aneurysms, and five patients had isolated iliac artery aneurysms. Bifurcated stent grafts were placed in 86 of 92 patients, including one patient with an isolated iliac artery aneurysm. Two AAAs were treated with a Swedish aortouniiliac device and femorofemoral crossover graft. In the remaining four patients, iliac limbs and extender cuffs were used in various configurations to treat isolated iliac artery aneurysms.

Anatomic features. The vascular anatomy was measured and categorized in several ways with preoperative computed tomography scans and arteriograms. Mean (right and left sides) common and external iliac artery diameters were 15.9 mm and 8.7 mm, respectively. Mean maximal infrarenal aortic diameter was 5.2 cm, and mean infrarenal aortic neck diameter was 22 mm. Iliac artery tortuosity was categorized as minimal or absent in 16%, mild in 40%, moderate in 40%, and severe in 4% (Table I). Iliac artery calcification was similarly categorized as minimal or absent in 23%, mild in 56%, moderate in 17%, and severe in 4%. Asians had smaller external iliac artery diameters ($P = .0003$) and more tortuous iliac arteries ($P = .03$). The relationship between Asian ethnicity and iliac artery tortuosity is shown in Fig 1, and between Asian ethnicity and external iliac artery diameter in Fig 2.

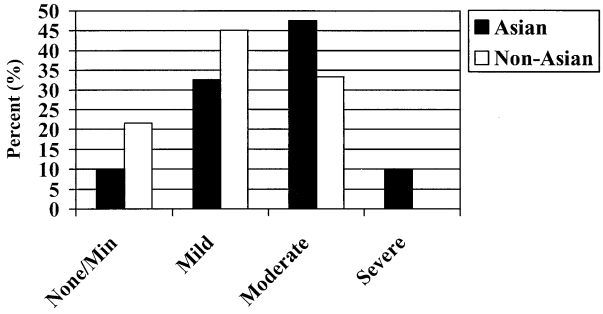

Fig 1. Degree of iliac artery tortuosity between Asian and non-Asian groups.

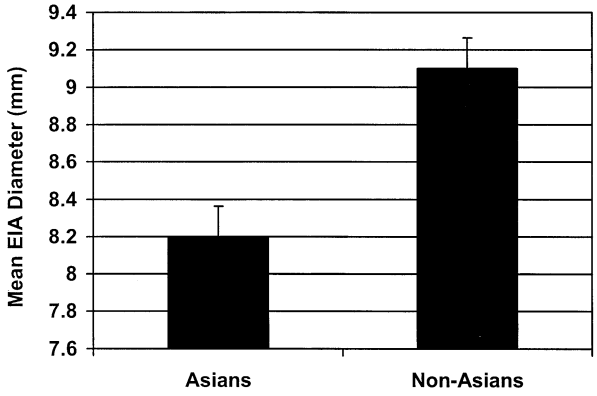

Fig 2. Mean external iliac artery *(EIA)* diameter stratified by ethnicity (Asian vs non-Asian). *Bars* indicate standard error. Difference was statistically significant ($P = .0003$, Student *t* test).

ADRCs. The purpose of this study was to test the hypothesis that persons of Asian ancestry are more prone to ADRCs after EVAR than non-Asians are. The definition of ADRCs used in this study is necessarily broad, to capture all adverse outcome events that might possibly be related to the challenging arterial anatomy that we believe is more prevalent in Asian persons. The main outcome variable in this study was the occurrence of adverse sequelae during or after the stent-graft procedure that were either related to difficulties with arterial access to the aorta from the femoral arteries or associated with device failure at the attachment sites, including complications such as graft limb occlusions, such as seen in incidences of unsupported graft material and type I endoleak. These complications are collectively termed ADRCs.

Complications that satisfied this definition occurred in 11 of 92 patients (12%; Table II). Complications were defined as perioperative (within 30 days of procedure) or delayed, and as major or minor.

Risk factors for access-related complications. Study variables evaluated for possible association with the occur-

Table I. Characteristics of study population*

Characteristic	*Total*	*Asian*	*Non-Asian*	P†
Total patients (n)	92	40	52	
Vascular center				.3
Straub Hospital	45	22	23	
Kaiser Moanalua Medical Center	47	18	29	
Demographic data				
Age (mean ± SD)	76.5 ± 7.9	77.9 ± 8.3	75.4 ± 7.4	.14
Gender (% male)	78.3	67.5	86.5	.03
Race (%)				
Asian	43.5			
White	39.1			
Pacific Islander	16.3			
African American	1.1			
Comormid conditions (%)				
Clinical cardiac disease	52.2	47.5	55.8	.4
Chronic obstructive pulmonary disease	18.5	17.5	19.2	.8
Smoking history	70.7	65.0	75.0	.3
Clinical cerebrovascular disease	14.1	5.0	21.1	.03
Diabetes mellitus	22.8	20.0	25.0	.6
Hypertension	79.3	95.5	67.3	.001
Hyperlipidemia	54.3	62.5	48.1	.17
Previous abdominal surgery	35.9	47.5	26.9	.04
Vascular anatomy (mean ± SD)				
External iliac artery diameter (mm)	8.7 ± 1.2	8.2 ± 1.1	9.1 ± 1.1	.0003
Common iliac artery diameter (mm)	15.9 ± 8.3	16.4 ± 10.5	15.5 ± 6.1	.6
Maximal infrarenal aortic diameter (cm)	5.2 ± 1.3	5.0 ± 1.5	5.3 ± 1.1	.2
Aortic neck diameter (mm)	22.0 ± 2.6	21.8 ± 2.8	22.2 ± 2.4	.4
Iliac artery tortuosity (%)				
None or minimal	16.5	10.0	21.6	
Mild	39.6	32.5	45.1	
Moderate	39.6	47.5	33.3	
Severe	4.4	10.0	0.0	
Iliac artery calcification (%)				.4
None or minimal	23.1	25.0	21.6	
Mild	56.0	50.0	60.8	
Moderate	16.5	22.5	11.8	
Severe	4.4	2.5	5.9	
Type of stent-graft (%)				.7
AneuRx (Medtronic/AVE)	81.5	85.0	78.9	
Ancure (Guidant)	10.9	10	11.5	
Excluder (W. L. Gore & Associates)	5.4	2.5	7.7	
Ivancev	2.2	2.5	1.9	

*Values represent total population, and then stratified by Asian vs non-Asian ethnicity.
†*t* test used for continuous variables; χ^2 test used for categorical variables.

rence of ADRCs included vascular center (Straub Hospital vs Kaiser Permanente), age, gender, race, comorbid conditions, vascular anatomy, and type of stent graft. All factors with at least weak ($P < .2$) associations are included in Table III. Variables such as comorbid conditions and type of stent graft were not associated with the occurrence of ADRCs ($P > .2$). The effect of iliac artery calcification was added for comparison with iliac tortuosity.

Asian ethnicity and external iliac artery diameter less than 7.5 mm were strong univariate risk factors for the occurrence of ADRCs (Table III). Asian patients were at 7.3-fold risk for ADRCs compared with non-Asian patients ($P = .015$), and patients with external iliac artery diameter less than 7.5mm were at 5.9-fold risk for ADRCs compared with patients with diameters greater than 7.5 mm. Patient age was also associated with increased risk for ADRCs, and this association was largely limited to persons older than 80 years. Octogenarians were at 5.6-fold increased risk for ADRCs compared with non-octagenarians ($P = .02$). In addition, there were weak and statistically nonsignificant associations of vascular center, gender, and iliac artery tortuosity with risk for ADRCs.

Access-related complications and Asian ethnicity. ADRCs were noted in 11 of 92 patients (12%; Table II). Complications were either perioperative (within 30 days of procedure) or delayed, and either major or minor.

The effect of adjustment for important study covariates on the association between Asian ethnicity and risk for ADRCs is shown in Table IV. The association between Asian ethnicity and ADRCs remained statistically significant even after adjusting for age older than 80 years, vascular center, gender, and iliac tortuosity alone. When adjusted for external diameter less than 7.5 mm, the association became weakly significant ($P = .043$); when ad-

Table II. Complications related to access or device

Complication	*n*	*Presentation*	
		*Perioperative**	*Delayed*
Major complications (n = 10)			
Perioperative death from iliac rupture	1	X	
Conversion to open repair, inability to access	1	X	
Large retroperitoneal hematoma, iliac source	1	X	
Occlusion iliac limb requiring femorofemoral bypass	2	X	
Spinal cord ischemia, partial leg paralysis	1	X	
Atheroembolization, end-stage renal disease	1	X	
Type I iliac endoleak requiring open conversion, 18 mo	1		X
Type I iliac endoleak requiring endovascular repair	1		X
Occlusion of iliac limb requiring femorofemoral bypass	1		X
Minor complication (n = 1)			
Common femoral artery dissection requiring repair	1	X	

*Complications manifested within 30 days.

Table III. Univariate analysis of association of selected risk factors with access-related and device-related complications

Factor	*Complication*		
	OR	*95% CI*	P
Center			
Straub Hospital vs Kaiser Moanalua Medical Center	2.0	0.5, 7.3	.3
Age			
≥80 vs <80 years	5.6	1.4, 23.0	.02
Gender			
Female vs male	2.3	0.6, 8.9	.22
Race			
Asian vs non-Asian	7.3	1.5, 35.8	.015
External iliac artery diameter			
<7.5 vs ≥7.5 mm	5.9	1.5, 23.0	.01
Iliac tortuosity			
Moderate/severe vs mild/none	2.4	0.7, 8.9	.18
Iliac Ca^{++}			
Moderate/severe vs mild/none	1.4	0.3, 5.9	.6

OR, Odds ratio; *CI,* confidence interval.

Table IV. Effect of adjustment for important study covariates on association between Asian ethnicity and access-related and device-related complications (n = 11)

Model	*OR*	*95% CI*	P
Asian ethnicity	7.3	1.5, 35.8	.015
Asian ethnicity adjusted for each of the following alone			
Center	6.9	1.4, 34.5	.018
Age >80 years	6.0	1.2, 30.4	.032
Gender	6.7	1.3, 33.8	.022
EIA diameter <7.5 mm	5.5	1.1, 28.3	.043
Iliac tortuosity moderate/severe	6.5	1.3, 32.8	.024
Asian ethnicity adjusted for EIA diameter and iliac tortuosity	4.7	0.9, 25.6	.074
Asian ethnicity adjusted for all of the above	3.8	0.7, 21.9	.13

OR, Odds ratio; *CI,* confidence interval; *EIA,* external iliac artery.

justed for both external iliac diameter less than 7.5 mm and iliac tortuosity combined, the association between Asian ethnicity and ADRCs became clearly nonsignificant (P = .074). This implies that the association between Asian ethnicity and ADRCs was at least partly mediated by the increased prevalence of small external iliac arteries (<7.5 mm) and tortuous arteries in Asian patients.

Six complications that occurred in the Asian group, but not in the non-Asian group, may be related to access, but because they were not clearly related, were not included in the data analysis. These included iliofemoral deep vein thrombosis in three patients, transient exacerbation of renal insufficiency in two patients, and stroke in one patient. The possible relationship of these complications with access is described in the Discussion.

Endoleak. Endoleaks were detected in 18 of 92 patients (19.8%). Sixteen endoleaks were type II, and two were type I. Both type I endoleaks occurred at the distal (iliac) site, and were thought to be device-related and considered ADRCs. The type II endoleaks were not considered ADRCS, because they were probably unrelated to device performance. There was no association between age, gender, ethnicity, iliac artery size, or tortuosity and the detection of endoleaks in this study.

DISCUSSION

This study shows that Asian patients are more likely than non-Asian patients to experience an ADRC. We also found that mean external iliac diameters in Asians are significantly smaller than in non-Asians (P = .0003). The definition of ARDCs used in this study was necessarily broad, to capture all adverse outcomes that might possibly be related to the challenging arterial anatomy that appeared more prevalent in Asian persons. We analyzed the data with regard to access-related and device-related problems, and found that Asian race, external iliac artery diameter less than 7.5 mm, and age older than 80 years are each associated with a significant risk for complications (Table III).

We also studied the effects that adjustment for important covariates had on outcome, to understand what factors could explain the relationship observed between ethnicity and complication rate. Asian patients continued to show a significantly higher rate of ADRCs than non-Asians did, even after adjusting for age, gender, vascular center, and iliac tortuosity alone (Table IV). When adjusted for both external iliac diameter less than 7.5 mm and iliac tortuosity, the association between Asian ethnicity and ADRCs become nonsignificant (P = .074). This finding suggests that

the association between Asian ethnicity and ADRCs is at least partly accounted for and mediated by smaller external iliac arteries (< 7.5 mm) and more tortuous arteries in Asians.

Of interest, there were six complications that were not definitely related to access or device, but occurred in the Asian group, and may have been the result of difficult access and smaller iliac arteries. Three patients in this series had symptomatic iliofemoral deep vein thrombosis within 1 week of surgery. It is possible that these simply represent typical postoperative deep vein thromboses and are unrelated to arterial access. It is also possible that these thromboses may have been related to overstretching of the access artery with the sheath or delivery catheter, with resultant adjacent venous compression. Two additional patients had transient exacerbation of preexisting renal insufficiency, which required extension of their hospital stay by several days. In these two patients postoperative azotemia may have occurred in association with challenging arterial access, from increased dye load and greater risk for atheroembolization secondary to frequent guide wire and device manipulations. Finally, another patient had a major postoperative stroke, which may or may not have been related to guide wire manipulation near the aortic arch in a patient with difficult access anatomy.

No previously published reports have examined the effects of ethnicity on endovascular AAA surgery. However, a study by Collins et al[4] examined the relationship of race and open repair of AAA. These authors showed that after elective open aneurysm surgery, mortality is higher in African Americans than in whites. However, after controlling for preoperative risk factors, no significant difference between races was found.

The ethnic mix in this study closely represents the general ethnic population of Hawaii. On the basis of the US census for 2000, the report of single race groups were 41.6% Asian, 24.3% white, 9.4% Native Hawaiian and Pacific Islander, 1.8% African American, and 0.3% American Indian and Alaska Native. In this study the percentage of Asians and non-Asians was similar to that of the general population of Hawaii.

Female gender is associated with increased adverse outcomes of EVAR. We did not show a relationship of gender and outcomes, which could have been due to the small numbers in this study. Wolf et al[1] showed that women are at increased risk for intraoperative complications compared with men, primarily related to access. Mathison et al[5] demonstrated no difference between men and women with respect to morbidity and mortality after endovascular treatment. However, they did find a higher rate of aborted endograft procedures in women. Furthermore, for reasons not well understood, female gender is identified as a risk factor for endoleak after EVAR.[3] Sanchez et al[6] found that women are at higher risk for technical complications, conversion to open surgery, aborted procedures, and postoperative complications, compared with their male counterparts; however, mortality was the same. Ouriel et al[7] reported that women were older and had smaller aneurysms at the time of surgery compared with men, but the outcome was similar. There was a greater frequency of graft limb occlusion in women.

It appears that women have smaller aortas and arteries,[8,9] which could explain why women are at increased risk for access-related complications during EVAR compared with men.[1] Velazquez et al[10] found that women are more likely to have smaller iliac arteries, and shorter, dilated, and more angulated aortic necks. They concluded that, on the basis of these anatomic limitations, there is reduced applicability of endograft use in women than in men.

As age increases, morbidity and mortality after EVAR appears to increase. In our series we found that octogenarians were at 4.1-fold increased risk for ADRCs compared with non-octagenarians ($P = .01$). Buth and Laheij[3] showed an increased rate of systemic complications in patients 75 years and older undergoing EVAR. In a report from Italy, Zannetti et al[2] found that patients with American Society for Anesthesiology class IV disease, primarily older patients with a mean age of 74 years, had significantly higher rates of systemic morbidity and mortality, and longer hospital stays, compared with those with class I to III disease with a mean age of 70 years.

This study is limited by the small sample size and retrospective design, which could explain why a statistical association between ADRCs and gender and iliac calcifications could not be found. Furthermore, although we found that smaller and more tortuous iliac arteries are more prevalent in Asians, inasmuch as patients were preselected for EVAR on the basis of strict anatomic criteria, the true values for iliac size and tortuosity relative to race were not clearly determined by this study, and deserve further investigation.

In conclusion, persons of Asian ancestry appear to be far more likely to experience adverse ADRCs compared with non-Asians. This association is in part due to smaller and more tortuous iliac arteries. The results emphasize the importance of careful patient selection for EVAR.

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DISCUSSION

Dr Lloyd M. Taylor (Portland, Ore).The foundation of this paper is a comparison of the occurrence of access and device-related complications in persons categorized as Asian versus all other patients, so my first question is, what constitutes Asian? Did you include persons of Turkish ancestry or those whose ancestors were from Kazakstan? And what about India? Is that part of Asia? All of Russia east of the Urals is in Asia. Did you include those whose ancestors came from there? I suspect you are really talking about patients whose ancestry is Chinese, Japanese, or Korean but you didn't say that. Then again what about the Philippines—Asian or Pacific Islander?

My second question has to do with where the ethnicity data came from. This was a retrospective review of patient records, so where did you get the information? Was it recorded in the chart? Did you record it separately in your own records, or was the ethnicity information from some other source? I am wondering about who decided about ethnicity? Did you ask the patients? In Hawaii many individuals trace their ancestry to multiple ethnic groups. What did you do about those of mixed ethnic background? Did you assign ethnicity retrospectively based upon surnames, or what exactly did you do?

The data suggests that the relationship between Asian ethnicity and complications can be mostly explained by smaller external iliac arteries, which are more frequently tortuous in Asian patients. So I wonder where the information about arterial diameters came from. Did you use the numbers recorded on the data sheets we fill out to size the devices? Or did you go back to the original CT data sets and remeasure the iliac artery diameters specifically for this study?

You used logistic regression carefully as is appropriate, but this statistical method is prone to profound errors when small numbers are involved. You didn't tell us how many patients had external iliac artery diameters smaller than 7.5 mm. If there were only a few and most had complications, this could have had a profound influence on your statistical analysis. I also wonder why you used external iliac artery diameter as a categorical variable. In other words, you said, less than 7.5 mm or greater, rather than as a continuous variable that it really is.

I note information in the manuscript was not in this presentation today, ie, that the average diameter of the aneurysms treated in this study was 5.2 cm. We have level 1 evidence based on large randomized trials that early repair provides no outcome improvement compared with observation for aneurysms up to 5.5 cm. You described your patients as, and I'm quoting from the manuscript, "a high-risk group of patients with advanced age and multiple medical comorbidities." Unless the diameter data is terribly skewed, approximately half of your patients had aneurysms considerably smaller than 5.5 cm. Please explain to me and the rest of the society how you can justify having advised them to have these procedures in view of the considerable morbidity you describe and in utter lack of any evidence of benefit.

Finally, I'm not sure what we are supposed to do with these data. I accept that we should be very careful about trying to place endografts through small tortuous external iliac arteries, but that is not a new finding. Indeed that advice is included in every manufacturer's package insert. I am willing to accept, I think, that persons of Asian ancestry may be more likely to have small iliac arteries, but since determination of external iliac artery diameter and tortuosity is mandatory before stent-graft repair, I am not sure how to use the information from this paper to improve patient care. Maybe you can help me out.

Dr Elna M. Masuda. This was a retrospective review with some limitation on the determination of ethnicity. In approximately one half of all patients, ethnicity was determined by interview at the time of their registration. In the other half, ethnicity was determined by chart review. Members of the Asian group were defined as any person whose primary ethnicity was Japanese, Chinese, Filipino or Korean, whereas the non-Asians were whites, Portuguese, and Pacific Islanders, including native Hawaiians and blacks.

The arterial diameter of the external iliac and common iliac arteries were determined by CT angiography and by using digital calipers. The data were retrieved by going back to all the CT scans and remeasuring the vessels, which we felt was more accurate and complete than using the data sheets that were used to size the device.

We found that external iliac artery diameters <7.5 mm were associated with a statistically significant higher complication rate than those >7.5 mm. Therefore, the data were analyzed and presented to show our findings.

One very interesting and controversial point is at what size should an AAA be repaired. Despite publications of prospective studies showing that surgery is not beneficial until the aneurysm is 5.5 cm, in reality there are still many surgeons including myself who feel that treating a 5.0-cm aneurysm electively is warranted, particularly if the person is of small stature or female. Unfortunately, there are no large studies examining the relationship of AAA rupture and stature. It remains unknown whether smaller aortas with aneurysms have a higher chance of rupture than larger aortas with the same aneurysm size.

Finally, the paper was meant to emphasize the importance of patient selection. Since Asians have smaller arteries than non-Asians, current devices may be less applicable to this group.

Dr Timothy Chuter (San Francisco, Calif). These data show what happens when you treat Asians with a device designed for Europeans who have different anatomy and smaller external iliac anatomy. Clearly, smaller delivery systems are required.

I was intrigued by the statistically borderline finding of an increased rate of distal type 1 endoleak, because I hear that my colleagues from Australia experience distal implantation problems when they supervise cases in Japan or China. Apparently, short wide common iliac arteries are common in this group.

The message to take away from this presentation relates not to what we should do but what industry should do. Most people in the world are not of Europeans descent. Smaller Asian patients need smaller stent grafts and smaller delivery systems.

Dr Christopher Zarins (Stanford, Calif). What do we do now with small access vessels that occur not only in Asians but also in women and some men? I just wonder whether or not you have considered the use of conduits. Iliac conduits when used in small iliac arteries really take away the issue of the small access vessel, such as the small external iliac artery. Have you now contemplated that or have you used iliac conduits to eliminate the access issues in the small iliac artery?

Dr Masuda. We have been using iliac conduits selectively and have found them very useful. It allows us to apply the currently available stent-graft devices to a larger number of patients. Otherwise, if the external iliac arteries are too small, we exclude them from the endograft treatment and instead treat them by the open technique.