

# The current management of isolated degenerative femoral artery aneurysms is too aggressive for their natural history

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**Background:** Previous studies have combined anastomotic, catheter-induced, and atherosclerotic isolated femoral artery aneurysms (FAAs) to achieve adequate numbers for analysis and have recommended repair of asymptomatic FAAs with diameters  $\geq 2.5$  cm and all symptomatic FAAs. This study evaluated the contemporary management of isolated FAAs.

**Methods:** Patients with FAAs were evaluated using a standardized, prospectively maintained database by a research consortium.

**Results:** From 2002 to 2012, 236 FAAs were identified in 182 patients (mean age, 72 years; male-to-female ratio, 16:1) at eight institutions. The mean nonoperative mean diameter was  $2.8 \pm 0.7$  cm, and the operative diameter was  $3.3 \pm 1.5$  cm. FAA location was the common femoral artery in 191, superficial femoral artery (SFA) in 34, and profunda femoris artery in 11. Synchronous aneurysms (mean, 1.7 per patient) occurred in the aorta ( $n = 113$ ), in the iliac ( $n = 109$ ), popliteal ( $n = 86$ ), and hypogastric ( $n = 56$ ) arteries, and in the contralateral common femoral artery ( $n = 34$ ), SFA ( $n = 9$ ), and profunda femoris artery ( $n = 2$ ). Of the aneurysms repaired, 66% were asymptomatic; other indications for repair were claudication (18%), local pain (8%), nerve compression (3%), rupture (2%), acute thrombosis (1%), and rest pain (0.5%). Acute aneurysm-related complications (rupture, thrombosis, embolus) were associated ( $P < .05$ ) with FAA diameter  $>4$  cm and intraluminal thrombus, but not location. Mean diameter of asymptomatic aneurysms that developed acute complications was  $5.7 \pm 1.3$  cm for rupture,  $4 \pm 1.1$  cm for thrombosis, and 3.5 cm for embolus. Repair was by interposition or bypass graft in 177 FAAs and by endovascular repair in three SFA aneurysms. Two perioperative deaths, of myocardial infarction and multisystem organ failure, occurred at 30 days. Operative complications included wound infection (6%), seroma (3%), and bleeding (2%). No amputations occurred through 5 years in the operative or nonoperative groups. Survival in operated-on patients was 99% ( $n = 138$ ) at 3 months, 92% at 1 year, and 81% ( $n = 20$ ) at 5 years.

**Conclusions:** This largest study of isolated FAAs demonstrates that (1) acute complications did not occur in FAAs  $\leq 3.5$  cm, repair criteria of asymptomatic FAAs should be changed to  $>3.5$  cm, and chronic intraluminal thrombus should reduce the threshold for repair, and that (2) current indications for symptomatic FAA repair result in low morbidity and should remain unchanged. (*J Vasc Surg* 2014;59:343-9.)

Degenerative femoral artery aneurysms (FAAs) are rare; they occur in approximately five patients per 100,000.<sup>1</sup> Current recommendations for treatment of asymptomatic degenerative (atherosclerotic) FAAs are to repair those with a maximum diameter  $\geq 2.5$  cm, but these criteria were derived  $>30$  years ago in an era when current imaging

techniques and operative and endovascular procedures were not available.<sup>2,3</sup> In addition, most published FAA studies mix anastomotic, atherosclerotic, mycotic, post-traumatic, and pseudoaneurysms.<sup>4-6</sup> These studies also emphasize that the natural history of FAAs remains relatively unknown, so there is little consensus regarding the treatment criteria for asymptomatic FAAs. The objective of our study was to examine the current management and outcomes of degenerative FAAs in a large cohort of patients, using a standardized multi-institutional approach, and to re-examine the criteria for repair of asymptomatic, isolated FAAs.

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## METHODS

**Literature review and analysis of local experience.** A MEDLINE search was conducted using the keywords *degenerative*, *atherosclerotic*, *arteriosclerotic*, *true*, *femoral*, and *aneurysm* to identify English-language articles published in the past 30 years related to FAAs. Demographic, diagnostic, preprocedural imaging, procedural details, and postoperative complications and outcomes considered important in each of the studies were entered into a data collection worksheet.

Femoral aneurysms were defined by using Society for Vascular Surgery Clinical Practice Guideline for aneurysms as a focal, isolated dilatation of all three layers of the arterial wall that measured at least 1.5 times the diameter of the disease-free proximal adjacent arterial segment.<sup>7</sup> The analysis excluded patients with continuous aneurysms originating in the external iliac artery or extending into the popliteal arteries because they met the definition of arteriomegaly, which may have a different natural history.

After approval by the University of California, Los Angeles (UCLA) Institutional Review Board (IRB), patients treated at UCLA during a 10-year interval from 2002 to 2012 with common femoral artery (CFA), profunda femoris artery (PFA), and superficial femoral artery (SFA) aneurysms were entered into the database using International Classification of Diseases, 9th edition (ICD-9) codes (442.3, 442.8) and Current Procedural Terminology (CPT; American Medical Association, Chicago, Ill) procedural codes (37205, 37799, 37226, 35141, 35142).

Patients with degenerative FAAs were reviewed for demographic, comorbidities, and risk factors, along with perioperative, operative, pathologic, initial, and long-term outcomes. Imaging studies, operative records, endovascular and open surgery operative reports, and pathologic reports were used to differentiate pseudoaneurysms, mycotic, anastomotic, and post-traumatic aneurysms from atherosclerotic FAAs. The UCLA experience with FAAs was presented at the 2010 Southern California Vascular Surgery Society Annual Meeting.

**Database development.** Key questions that could not be answered from the single-institution UCLA study of FAAs, due to small patient numbers, became the basis for an expanded new multi-institutional study. The existing database was revised to address the added information learned from the single-institution study. Invitations to participate in the multi-institutional study were sent to members of local and regional vascular societies, including the Southern California Vascular Surgery Society, the Rocky Mountain Vascular Society, and the Western Vascular Society, as well as institutions within the United States that had recently published reports on peripheral aneurysms.

Surgeons and institutions who expressed an interest in participating in a multi-institutional FAA study were sent study packages, which consisted of a summary of the UCLA single-institution experience, specific information to aid in obtaining IRB approval, a database collection form, and ICD-9 (442.3, 442.8) and CPT (37205, 37799, 37226, 35141, 35142) codes that would enable each institution or surgeon to identify patients who had been treated for isolated FAAs. Participating institutions and surgeons were assisted in the IRB approval process by members of the UCLA multi-institutional study team, who were available throughout the entire study.

**Database management.** Once the study was approved at each institution, data were collected, deidentified, sent to a UCLA server, and stored in a password-encrypted central database managed by the Vascular Surgery Division at UCLA. Submitted patient data from each institution were

examined for accuracy and completeness; incomplete entries were resolved with each institution.

**Statistics.** All data were maintained in an Excel 14 database (Microsoft Corp, Redmond, Wash). Statistical analysis was performed using SPSS 20.0 software (IBM Corp, Armonk, NY). Continuous variables are presented as mean  $\pm$  standard deviation, unless noted otherwise. Differences among subgroups were analyzed using independent Student *t*-test, Kruskal-Wallis test, Mann-Whitney *U* test, and analysis of variance test. Differences among subgroups of noncontinuous variables were analyzed using the  $\chi^2$  test or the Fisher exact test. Multivariable analysis was performed using binary and multinomial logistic regression. Cochran and Mantel-Haenszel methods were used for hazard ratios and 95% confidence intervals. All time-dependent variables were analyzed using Kaplan-Meier life-tables. A *P* value of  $<.05$  was considered significant.

## RESULTS

**Demographics and risk factors.** Between 2002 and 2012, 236 isolated degenerative FAAs were identified in 182 patients at eight institutions from different regions of the United States. The mean age at diagnosis was  $72 \pm 10$  years (range, 21-89 years). FAAs occurred predominantly in men (male-to-female ratio, 16:1). Risk factors and comorbidities are summarized in Table I and included smoking, hypertension, hyperlipidemia, coronary artery disease, peripheral arterial disease (other than the aneurysm), diabetes mellitus, and dialysis-dependent chronic renal insufficiency.

The distribution of aneurysms in the three anatomic segments of the femoral artery (CFA, PFA, and SFA) is shown in Fig 1. Synchronous and metachronous aneurysms were identified in the aorta as well as unilaterally and bilaterally in the external iliac, hypogastric, PFA, SFA, and popliteal artery (Fig 1). At the initial evaluation, 156 aneurysms (66%) were asymptomatic; the clinical presentation of all FAA patients and aneurysms is reported in Table II. Large FAA diameter, presence of intraluminal thrombus in the aneurysm, and PFA aneurysms were all significantly more common among symptomatic patients (Table III).

**Preoperative data.** In addition to FAA identification by physical exam, imaging modalities that were used to confirm the diagnosis, determine location and size, and assess for intraluminal thrombus in the FAAs included computed tomography in 127 (70%), duplex ultrasound imaging in 70 (38%), conventional angiography in 57 (31%), and magnetic resonance imaging in 18 (10%). The mean aneurysm diameter for all patients was  $3.2 \pm 1.4$  cm (maximum, 10 cm). The mean (standard error of the mean) preoperative ankle-brachial index was  $0.93 \pm 0.02$ .

The management used for patients with degenerative FAAs, since the initial evaluation, is shown in Fig 2. After the initial evaluation, 114 patients with 156 FAAs were observed without definitive treatment. Of these patients initially managed conservatively, 73 (64%) later underwent operative repair for indications, including development of intraluminal thrombus in 46, size increase to  $\geq 2.5$  cm in

**Table I.** Demographics and cardiovascular risk factors for patients with degenerative femoral artery aneurysms (FAAs)

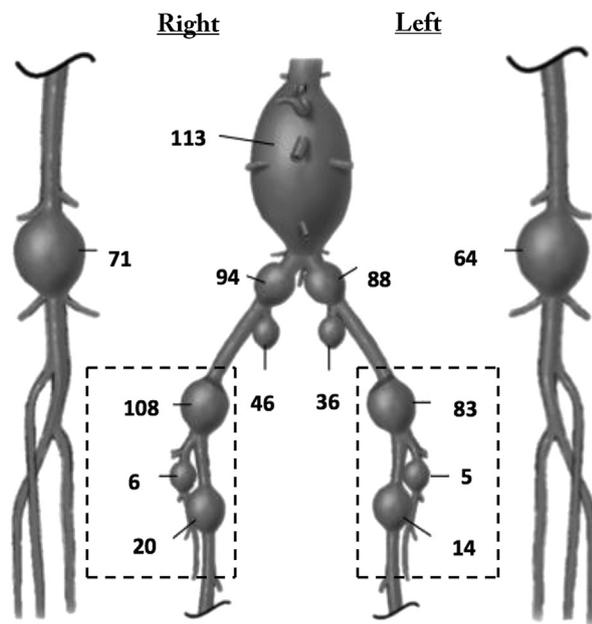
Variable	Mean ± SD or No. (%) (N = 182)
Age, years	72 ± 10
Male gender	171 (94)
Cigarette smoking	139 (76)
Hypertension	136 (75)
Hyperlipidemia	97 (53)
Coronary artery disease	92 (51)
Peripheral arterial disease	55 (30)
Diabetes	27 (15)
Dialysis-dependent	3 (2)

SD, Standard deviation.

**Table II.** The clinical presentation of all patients and degenerative femoral artery aneurysms (FAAs) at the initial evaluation

Variable <sup>a</sup>	Patients (n = 182)	Aneurysms (n = 236)
Diameter, cm	3.2 ± 1.4	3.2 ± 1.4
Asymptomatic	114 (63)	156 (66)
Palpable mass	42 (29)	55 (23)
Claudication	43 (22)	43 (18)
Local pain	19 (10)	19 (8)
Rupture	3 (2)	3 (1)
Thrombosis	2 (1)	2 (1)
Rest pain	1 (1)	1 (<1)

<sup>a</sup>Continuous data are shown as mean ± standard deviation and categorical data as number (%).



**Fig 1.** The locations and distribution are shown of degenerative femoral artery aneurysms (FAAs; dotted boxes) and additional synchronous and metachronous aneurysms. Forty-seven patients (26%) had bilateral degenerative FAAs.

35, acute complications in 12, and rapid enlargement in 7 (Fig 3). Of the 12 patients who developed acute complications, 7 (6%) underwent emergent repair for FAA rupture (mean FAA diameter, 5.7 ± 1.3 cm), 3 (3%) for FAA thrombosis (mean FAA diameter, 4.0 ± 1.1 cm), and 2 (2%) for FAA embolization (mean FAA diameter, 3.5 cm). Age, diameter, and the presence of intraluminal thrombus were statistically significant factors associated with acute aneurysm-related complications and were also indications for operative repair in patients who were asymptomatic at the initial evaluation (Table IV).

**Operative data.** Surgical repair was performed in 141 patients with 180 aneurysms (76%; Fig 3), with 177 FAAs (98%) treated by an open surgical approach; only three

**Table III.** Differences and similarities in patient characteristics between patients who were symptomatic and asymptomatic at the initial evaluation

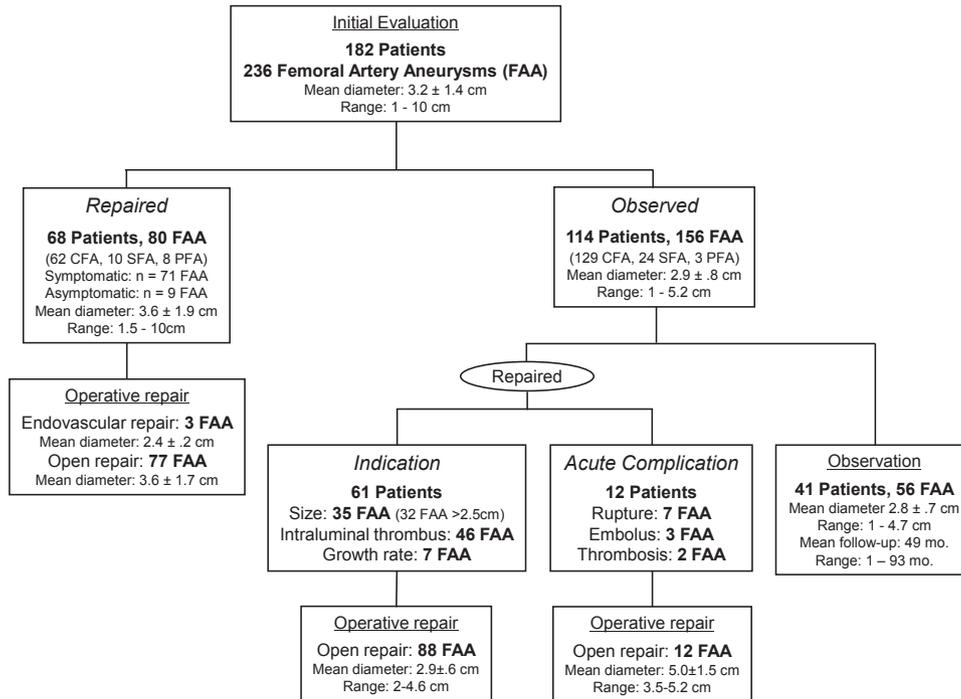
Variable <sup>a</sup>	Symptomatic (n = 68)	Asymptomatic (n = 114)	P
Age, years	72 ± 10	72 ± 10	.92
Male gender, %	96	95	.551
FAA			
Max diameter, cm	3.6 ± 1.9	2.9 ± 0.8	<.001
Length, cm	5.8 ± 3.4	4.4 ± 2.2	.07
Intraluminal thrombus, %	66	25	<.001
PFA aneurysm, %	10	2	.005

FAA, Femoral artery aneurysm; PFA, profundus femoris artery.

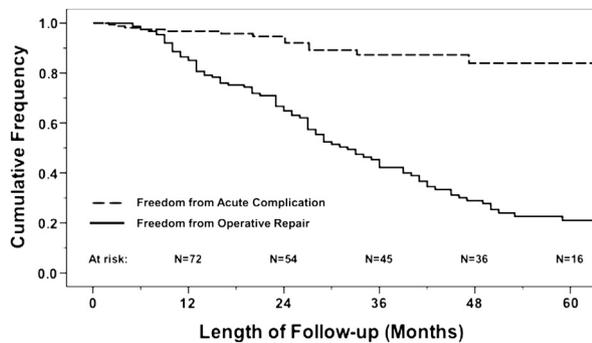
<sup>a</sup>Continuous data are shown as mean ± standard deviation and categorical data as indicated.

patients (2%) underwent percutaneous endovascular repair of their SFA aneurysms. The most frequent indications for repair were pain, intraluminal thrombus, and size ≥2.5 cm; other indications are reported in Table V. Open surgical procedures included interposition graft in 142 FAAs (80%) and bypass in 35 (20%). Bypasses were most frequently from the external iliac artery to the CFA (n = 12 [34%]), proximal SFA (n = 9 [26%]), and PFA (n = 8 [23%]) but also from the SFA to the tibial artery (n = 2 [6%]). Aneurysms that were surgically repaired were significantly greater in diameter than those managed conservatively (operative FAA mean diameter, 3.3 ± 1.5 cm; P = .001). One patient died intraoperatively of multisystem organ failure.

**Perioperative data.** The 30-day mortality for operative patients was 1.1% (n = 2; Fig 2). Major postoperative complications developed in 27 patients (20%), including wound infection/seroma/hematoma in 17 (12%), respiratory failure in 4 (3%), acute lower extremity ischemia in 2 (1.5%), acute renal insufficiency in 2 (1.5%), compartment syndrome in 1 (1%), and deep venous thrombosis in 1 (1%). No correlation was found between symptomatic or acute presentation and perioperative complications. The median hospital length of stay was 4 days (mean, 7 ± 4 days).



**Fig 2.** Flowchart shows the management used for patients with degenerative femoral artery aneurysms (FAAs). CFA, Common femoral artery; PFA, profundus femoral artery; SFA, superficial femoral artery.



**Fig 3.** Kaplan-Meier life-table shows freedom from acute complication and operative repair for patients asymptomatic at the initial evaluation.

**Follow-up data.** Of the patients who underwent surgical repair of their FAAs, 179 (99%) were available for 30-day follow-up. The cumulative survival for operated-on and observed patients was comparable out to 5-years of follow-up (Fig 4). One patient developed an open wound infection within 6 months of surgery. None developed critical limb ischemia or underwent an amputation during the follow-up period. The mean ankle-brachial index value postoperatively for the patient’s index limb at 1 year was 0.91. The mean length of follow-up was 49 months (range, 1-93 months). One patient (1%) had femoral graft-related complications, and 35 patients (27%) died of nonaneurysmal-related causes.

**Table IV.** Multivariable analysis of factors associated with acute aneurysm-related complications and indications for operative repair in patients who were asymptomatic at the initial evaluation

Variable	HR (95% CI)	P
Diameter ≥4 cm	5.192 (1.535-17.564)	<.001
Intraluminal thrombus	4.386 (1.221-15.756)	<.001
Age <60 years	3.882 (1.382-13.224)	.004
Ipsilateral FAA	3.083 (0.874-10.878)	.08
Rapid expansion	1.384 (0.146-18.640)	.741
Contralateral FAA	1.180 (0.343-4.058)	.793
Popliteal aneurysm	.603 (0.186-1.961)	.755

CI, Confidence interval; FAA, femoral artery aneurysm; HR, hazard ratio.

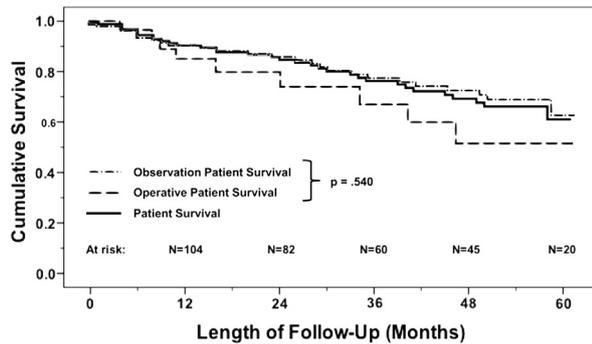
The life-table cumulative survival rate of all patients was 94.5% at 6 months and 61.1% at 5 years (Fig 2), and limb salvage was 100% in patients who remained alive during the 5-year follow-up period. Survival between symptomatic and asymptomatic patients did not differ significantly (Fig 5).

**DISCUSSION**

This study represents the largest series of degenerative FAAs reported in the literature, but equally important is that it assesses patients during the last 10 years, in an era where sophisticated imaging, such as duplex ultrasound, computed tomography, and magnetic resonance angiography, are routinely used and where surgery and

**Table V.** Indications for repair of all degenerative femoral artery aneurysms (FAAs)

Variable	No. (%) (N = 180)
Pain	62 (34)
Intraluminal thrombus	49 (27)
Size $\geq 2.5$ cm	41 (23)
Rupture	10 (6)
Enlargement	7 (4)
Thrombosis	5 (3)
Femoral nerve compression	4 (2)
Distal embolization	2 (1)

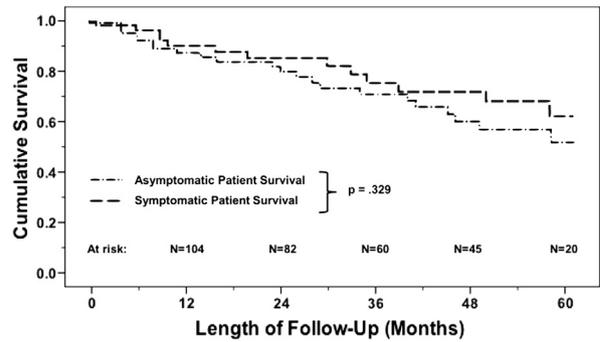


**Fig 4.** Kaplan-Meier life-table shows the survival rates of patients managed operatively compared with nonoperatively. A Tarone-Ware test was used to determine the degree of difference.

endovascular techniques are both available for treatment. The conclusions of this study are that asymptomatic degenerative FAAs rarely develop a complication unless they are  $\geq 3.5$  cm and have intraluminal thrombus. However, the location of FAAs that developed complications, whether they originated in the CFA, PFA, or SFA, was not significant, and the behavior of the aneurysms was not different, based on location, as long as the aneurysms were isolated.

The natural history of degenerative FAAs is not well documented because of their low frequency, so many authors base treatment guidelines on popliteal artery aneurysms. They assume that peripheral artery aneurysms behave in a similar manner and, therefore, recommend similar criteria for repair of FAAs.<sup>6,8</sup> Most current textbook recommendations for treatment of asymptomatic FAAs use a size  $\geq 2.5$  cm and FAAs that are found to be rapidly enlarging.<sup>8</sup> These criteria became the “standard” during an era when precise vascular imaging was often not available and pseudoaneurysms and anastomotic graft aneurysms were mixed with degenerative aneurysms.

The emergence of high-quality noninvasive vascular imaging provides more objective methods of determining the etiology, sizing FAAs, assessing for intraluminal thrombus, and defining their anatomy. Our results indicate that FAAs have a more benign natural history than popliteal artery aneurysms, contradicting the assumptions underlying the existing recommendations, which assume the two are similar.<sup>9,10</sup>



**Fig 5.** Kaplan-Meier life-table shows survival rates of patients with asymptomatic aneurysms compared with symptomatic aneurysms. A Tarone-Ware test was used to determine the degree of difference.

Acute complications in otherwise asymptomatic FAAs are exceedingly rare, and thrombosis and embolus are more common than rupture.<sup>11-13</sup> The incidence of these complications in prior studies is variable, and some studies correlated complications with specific femoral vessels. In one of the earliest reports of multiple etiology FAAs, published by Cutler and Darling,<sup>3</sup> acute complications occurred in 43%, and thus, aggressive surgical treatment for all patients was advocated. In contrast, Graham et al<sup>14</sup> reviewed the results of 172 arteriosclerotic FAAs in 100 patients and found that only three patients managed conservatively had complications and thus advocated a less aggressive treatment approach after their experience demonstrated a much more benign natural history. FAA complications in our series occurred primarily in patients with intraluminal thrombus in the aneurysm, and none occurred in aneurysms  $< 3.5$  cm in maximum diameter.

Prior studies have found the incidence of thrombosis or embolus was 15% in CFA, 45% in PFA, and 26% in SFA aneurysms.<sup>15,16</sup> These authors suggested that the abnormally high rate for PFA thrombosis and embolus was the result of the aneurysm’s location deep in the thigh, so most PFA aneurysms go undetected until they become large and symptomatic. Only five patients (3%) in our study had thrombosis or embolus, with no significant correlation with the specific section of femoral artery involved.

In our series, rupture occurred with similar frequency as thrombosis or embolus and in a higher percentage of PFA and SFA aneurysms; when occurred in a CFA, the aneurysm was  $> 5$  cm in diameter. Although only  $\sim 40$  cases of isolated SFA aneurysms have been reported, some authors have recommended repair of all SFA aneurysms to avoid rupture and embolization<sup>12</sup>; our series found that only 4% of FAAs ruptured. Our results suggest that aneurysms  $< 3.5$  cm in maximum diameter have a low risk of rupture and can be observed and monitored for evidence of rapid aneurysm expansion.

The significance of intraluminal thrombus and its contribution to acute complications has been postulated, based on its embolic potential, yet no prior studies have demonstrated a significant relationship.<sup>4</sup> We found that

the presence of intraluminal thrombus was correlated with symptomatic patients and asymptomatic patients who then developed an acute embolic or thrombolytic complication. Multivariable analysis showed that FAAs >4 cm with intraluminal thrombus are at significant risk for complications; therefore, we recommend that intraluminal thrombus be a factor used when deciding to treat an FAA and that the presence of thrombus should reduce the size threshold for elective repair.

The association between FAAs and abdominal aortic aneurysms and other peripheral arterial aneurysms has been well established, but the incidence varies between studies<sup>15,17</sup>; synchronous femoral and aortic aneurysms occur in 50% to 90%,<sup>9,18</sup> synchronous popliteal artery aneurysms in 27% to 44%,<sup>15,17</sup> and synchronous contralateral FAAs in ~26% to 50%.<sup>4,19</sup> The frequency of aortic and contralateral femoral aneurysms in our series are comparable to the recently reported results of Piffaretti et al,<sup>4</sup> who found that 26% of FAA patients had bilateral FAAs and 48% had additional central and peripheral artery aneurysms. The high prevalence of additional arterial aneurysms indicates that degenerative FAAs are a marker for systemic aneurysmal disease.

Our assumption is that the large range of reported prevalences for these aneurysms is the result of variations in arterial screening or follow-up imaging of the abdominal and contralateral peripheral vessels. We therefore believe the true prevalence of synchronous and metachronous aneurysms may be much higher than the current literature suggests. The implication of not identifying all aneurysms, particularly those that are asymptomatic, is that the rate of developing an acute complication may be overestimated. We recommend that all patients found to have degenerative FAAs be screened for additional arterial aneurysms with abdominal and lower extremity duplex ultrasound or computed tomography imaging.

One of the main limitations of this study is its retrospective design, which precludes capture of all FAAs, including those untreated. Most studies are limited to patients who were referred to centers that treat FAAs; consequently, a large number of asymptomatic FAAs may be undiagnosed or untreated. The true prevalence of FAAs would require a national screening study, which is presently not economically feasible and thereby limits our ability to measure the true prevalence of synchronous aneurysms. The true natural history of degenerative FAAs also remains relatively unknown. To conclusively determine the risk of rupture, thrombosis, and embolism would require a prospective trial of asymptomatic aneurysms >2.5 cm in diameter, which are observed indefinitely.

## CONCLUSIONS

This large study of isolated degenerative FAAs demonstrates that acute complications are rare and did not occur in aneurysms <3.5 cm in diameter. We therefore believe that the criteria for repair of asymptomatic FAAs should be changed to  $\geq 3.5$  cm. Intraluminal thrombus is an additional indication for elective repair and should be a factor

when considering the size threshold for elective FAA repair. The current indications for symptomatic FAA repair result in low morbidity and should remain unchanged.

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## AUTHOR CONTRIBUTIONS

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Writing the article: PF, MH-L

Critical revision of the article: PF, MH-L, GO, MH, GL, JB, CA

Final approval of the article: PF, MH-L, GO, MH, GL, JB, CA

Statistical analysis: MH-L

Obtained funding: Not applicable

Overall responsibility: PF

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## DISCUSSION

**Dr Michele Carmo** (*Milan, Italy*). My first question is about your recommendation of a new threshold of 3.5 cm, which, if I understood well, is based on the observation of a cohort of patients where you operated on patients who reached the 2.5 threshold. And, this doesn't make a lot of sense to me, because I would rather make this recommendation after following a cohort of patients where surgery was delayed at the 3.5 threshold and no complications were observed.

**Dr Gustavo Oderich**. The average diameter in the cohort who underwent observation was 3 cm, and after a mean follow-up of 49 months, there were no complications among patients with aneurysms <3.5 cm. Yes, we have not followed patients indefinitely and 61 of 114 patients were repaired for "growth" or size >2.5 cm, with average size of 2.9 cm in this subset of patients. If we look at the 12 patients that had an acute event, the average size was 5 cm; and in fact, there was one patient with a 3.5-cm aneurysm, and the others had aneurysms significantly larger than 4 cm.

So, the best recommendations we can make based on this retrospective review are that there were no complications for aneurysms <3.5 cm, and therefore this size can be considered as a new threshold for repair. I do agree the study has limitations due to the design and lack of predefined protocol, but it does show that complications have not occurred in smaller aneurysms, and most certainly there is little evidence that repair is really needed earlier for smaller aneurysms.

**Dr Carmo**. My second question is: would you recommend a lower threshold for patients with a particularly active life, for example, riding a bike or gardening, where hip movements can have some impact?

**Dr Oderich**. This study also shows that even in a multicenter experience, the repair can be done safely with very low mortality and morbidity. So, it's difficult to argue not to repair a patient that is young, healthy, and has a very active lifestyle as you outlined. Our data have shown that age <60 years old was independently associated with higher rates of aneurysm complications. I do think that it is reasonable to repair the aneurysm at a smaller size, larger than 2.5 cm, in a younger patient, particularly if there is growth or any concern due to thrombus.

**Dr Kamran Karimi** (*Cedar Falls, Iowa*). Would your threshold of repair be different in a common femoral artery aneurysm if the superficial femoral artery is occluded?

**Dr Oderich**. Good question. We analyzed the threshold as a group. But, evidently as we move distal on the circulation, that may not necessarily apply. The few superficial femoral artery aneurysms included in this study were in the very proximal, encroaching

the common femoral artery. For distal superior femoral artery aneurysms, we use the same recommendations as for popliteal aneurysms.

**Dr George Hamilton** (*London, United Kingdom*). You've got potentially two groups here. I just wonder whether you analyzed for the effect of best medical therapy and particularly the use of statins. Did you find a difference between the two? In other words, the groups that you didn't operate on that didn't expand and the group that did.

**Dr Oderich**. Well, the credit really goes to Dr Lawrence. He has a number of other ongoing projects, and I would welcome the membership to contact him if interested in collaborating.

**Dr Hamilton**. The question was really about the use of statins and best medical therapy, not endovascular therapy.

**Dr Oderich**. To answer your question, we have no information on medical therapy.

**Dr George Meier** (*Cincinnati, Ohio*). Gustavo, I noticed that your length of stay was 7 days on average. Was that due to outliers, or were they really in the hospital that long? It seems longer than I would expect.

**Dr Oderich**. I agree. One limitation of the data set is that there is a number of patients who had concomitant aortic repair, explaining the longer length of stay. And, perhaps Dr Lawrence can comment on that, but that is a limitation of the data set and I don't have the information on the details of that.

**Dr Peter Lawrence** (*Los Angeles, Calif*). This database approach provides a very large data set, but there are some limitations to analysis. The prolonged length of stay reasons are unique to each institution, but they are skewed by the emergent femoral aneurysms with thrombolysis and amputation. Also this is a 10-year study, so the data go back to an era when length of stay was not such a big issue. I believe that length of stay would be much shorter if the data were collected in 2013, particularly for those patients who had an elective femoral aneurysm repair.

**Dr Rombout Kruse** (*Zwolle, The Netherlands*). Very interesting to see these diseases being treated in your presentation that are so rare. I have a question about the groin infections. If I have it correct, you saw 12% groin infections. Did you use in your study only Dacron, or did you also use venous interposition or other materials?

**Dr Oderich**. The rate of 12 complications actually includes a combination of all wound-related complications and that consists of seromas, lymphatic leaks, and infections. The most common conduit used is polyester graft. Vein has not been used to replace at least in a larger number of patients.