Published in final edited form as:
Ann Vasc Surg. 2022 October ; 86: 199–209. doi:10.1016/j.avsg.2022.05.007.

Gender Disparities in Aortoiliac Revascularization in Patients with Aortoiliac Occlusive Disease

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Abstract

Background: Gender disparities have been previously reported in aortic aneurysm and critical limb ischemia outcomes; however, limited info is known about disparities in aortoiliac occlusive disease. We sought to characterize potential disparities in this specific population.

Material and Methods: Patients who underwent aortobifemoral bypass and aortic thromboendarterectomy (Current Procedural Terminology codes 35646 and 35331) between 2012 and 2019 were identified in the National Surgical Quality Improvement Program database. A binomial regression model was used to estimate gender differences in 30-day morbidity and mortality. Inverse probability weighting was used to standardize demographic and surgical characteristics.

Results: We identified 1,869 patients, of which 39.8% were female and the median age was 61 years. Age, body composition, and other baseline characteristics were overall similar between genders; however, racial data were missing for 26.1% of patients. Females had a higher prevalence of preexisting chronic obstructive pulmonary disease (20.9% vs. 14.7%, prevalence difference 6.1%, $P < 0.01$), diabetes mellitus (25.4% vs. 19.4%, prevalence difference 6.0%, $P < 0.01$), and high-risk anatomical features (39.4% vs. 33.7%, prevalence difference 5.8%, $P = 0.01$). Preprocedural medications included a statin in only 68.2% of patients and antiplatelet agent in 76.7% of patients. Females also had a higher incidence of bleeding events when compared to males (25.2% vs. 17.5%, standardized risk difference 7.2%, $P < 0.01$), but were less likely to have a prolonged hospitalization greater than 10 days (18.2% vs. 20.9%, standardized risk difference

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Declarations of Interest: None.

−5.0%, $P = 0.01$). The 30-day mortality rate was not significantly different between genders (4.7% vs. 3.6%, standardized risk difference 1.2%, $P = 0.25$).

Conclusions: Female patients treated with aortobifemoral bypass or aortic thromboendarterectomy are more likely to have preexisting chronic obstructive pulmonary disease, diabetes mellitus, and high-risk anatomical features. Regardless of a patient's gender, there is poor adherence to preoperative medical optimization with both statins and antiplatelet agents. Female patients are more likely to have postoperative bleeding complications while males are more likely to have a prolonged hospital stay greater than 10 days. Future work could attempt to further delineate disparities using databases with longer follow-up data and seek to create protocols for reducing these observed disparities.

INTRODUCTION

Peripheral artery disease (PAD) manifesting in the distal abdominal aorta and proximal common iliac arteries is termed aortoiliac occlusive disease (AIOD).[1] The underlying pathophysiology of AIOD is multifactorial and can progress to complete occlusion of the aortoiliac segment. Although the majority of patients are asymptomatic, common symptoms that can occur are lower extremity pain upon ambulation and erectile dysfunction in males.[1,2]

AIOD is the second most common manifestation of PAD and produces significant morbidity and mortality, including critical limb ischemia.[3] Nonoperative therapies such as lifestyle modification, smoking cessation, optimal management of other underlying conditions, and medications including statins, antiplatelet/anticoagulant agents, and antihypertensives can all provide therapeutic value.[4] Operative intervention includes open and/or endovascular strategies based on a patient's presentation, comorbidities, and anatomy of the lesions.[1,5,6]

Gender disparities have been observed in morbidity and mortality metrics following vascular surgical procedures, including lower extremity revascularization, with females suffering from increased complications when compared to males, independent of other risk factors.[2,7,8] A variety of hypotheses have been proposed, including suggestions that women present later and with more severe stages of PAD, are more likely to undergo emergency surgery, suffer from postmenopausal hormonal effects on vessels, and are more prone to have their PAD symptoms masked by or misattributed to arthritis or osteoporosis.[9–12] However, other studies have found that males suffer increased cardiovascular mortality, even with optimal medical management.[13]

To better understand potential disparities in the treatment of AIOD, we present this analysis which characterizes gender differences in surgical outcomes for patients undergoing aortobifemoral bypass (ABFB) and open aortic thromboendarterectomy (ATEA). This study uses data from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database participant use file (PUF), which is a risk-adjusted, surgical outcomes database contributed to by over 500 hospitals who voluntarily submit demographic, preoperative, and 30-day outcome information for their patients. We hypothesized that female and racial minority patients would suffer from worse outcomes in open procedures for treatment of AIOD.

MATERIALS AND METHODS

Study Design and Population

We conducted a retrospective cohort study analyzing data from the NSQIP PUF between January 1, 2012 and December 31, 2019. Our study included all patients in the aortoiliac targeted PUF who underwent ABFB or ATEA procedures (Current Procedural Terminology codes 35646 and 35331) during the study period.

Outcomes

The 30-day surgical outcomes assessed in this study included mortality, bleeding (requiring transfusion or a second procedure), prolonged length of stay (LOS, >10 days), reoperation, readmission, surgical site infection (SSI), prolonged ventilation, pneumonia, myocardial infarction or stroke, renal failure, wound disruption, venous thromboembolism, and amputation. SSI was defined as those reported in the NSQIP PUF to have developed superficial, deep, or organ/space SSIs. Data from the NSQIP PUF reported a frequency table of the number of patients with a hospital duration ranging from 0 to 97, and also included 7 participants (0.37%) with the frequency of "−99," presumably because duration was unknown. More than 10 days was chosen as the time point for defining prolonged LOS because we wanted to characterize whether this qualitative variable was associated with other outcomes.

Covariates

Demographic covariates included sex, age, and race. Preexisting health status was assessed based on body mass index (BMI), comorbidities such as congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), hypertension, smoking, cancer, diabetes mellitus (DM), postoperative bleeding complications, and functional independence. Surgical covariates included whether the procedure was elective, preprocedural statin, aspirin, and beta-blocker use, wound classification, American Society of Anesthesiologists (ASA) classification, symptoms, and physiologic and anatomic risk status.

Statistical Analysis

Patient demographics as well as clinical and procedural characteristics were described using frequency statistics for categorical variables, and medians and interquartile ranges for continuous variables. We compared the 30-day risk of morbidity and mortality between female and male patients. Crude and standardized risk differences (sRDs) were estimated using a binomial regression model. Wald chi-squared tests were used to assess differences by gender. Inverse probability weighting was used to standardize covariate distributions between female and male patients. Weights were estimated using logistic regression models that included age, year of operation, elective surgery status, BMI, comorbidities, functional independence, ASA classification, symptoms, and physical and anatomical risk status as covariates. High-risk anatomical features are defined by NSQIP as prior abdominal surgery, prior ipsilateral bypass involving the currently treated segment, or prior ipsilateral percutaneous intervention involving the currently treated segment. Race was not included in the model due to the proportion of patients with missing data (n = 488 or 26.1%).

We used additional binomial regression to assess whether there were gender disparities in preoperative risk factors and medication (statin and antiplatelet) adherence. Finally, we used similar models to assess the conditional risk of 30-day mortality by preoperative risk factors that adjusted for gender to assess inherent gender disparities in the associations between preoperative risk factors and 30-day mortality. Preoperative risk factors included ASA classification, comorbidities, smoking status, functional status, high risk factors (anatomic and physiologic), and symptoms. Differences between female and male patients were assessed using Wald chi-squared tests. For all analyses, a *P*-value <0.05 was considered statistically significant. All analyses were conducted using SAS Version 9.4 (SAS Inc., Cary, NC). The study was exempted from review by the Institutional Review Board at the University of North Carolina at Chapel Hill (IRB# 20-1493).

RESULTS

Baseline Characteristics

We identified 1,869 patients who underwent ABFB (n = 1,797 or 96.2%) and ATEA (n = 72 or 3.85%) in the NSQIP database between the years 2012 and 2019. Of these, 743 (39.8%) were female and 1,126 (60.2%) were male. Demographic measures such as median age (females: 62 years, males: 61 years), overall age distribution, BMI distribution, year of operation, percentage of elective versus emergent surgery, wound classification, and ASA classification were overall similar between genders, as demonstrated in Table I. The distribution of race was also similar between each gender; however, data on race were missing for 26.1% (n = 488) of subjects. Insurance status was not available for inclusion in our analysis. The overall rate of prescribed preprocedural medications was 68.2% for statins and 76.7% for antiplatelet agents (Table I). There was no significant difference between genders for prescribed rate of statins (69.2% female vs. 67.1% male, $P = 0.36$), antiplatelet agents (aspirin or clopidogrel) therapy (74.2% female vs. 77.7% male, $P = 0.10$), or combined use of statin and antiplatelet therapy (57.9% female vs. 58.8% male, $P = 0.74$).

Clinical Characteristics

A detailed look at preoperative clinical characteristics is presented in Table II. Females were more likely to have preexisting severe COPD (20.9% vs. 14.7%, prevalence difference 6.1%, $P < 0.01$), DM (25.4% vs. 19.4%, prevalence difference 6.0%, $P < 0.01$), and high-risk anatomical features (39.4% vs. 33.7%, prevalence difference 5.8%, $P = 0.01$). No statistically significant difference was observed between males and females for ASA classification, prior known bleeding conditions, CHF, hypertension, smoking status, cancer, functional status, or PAD symptoms.

Gender Differences

Risk differences for surgical outcomes comparing female and male patients are presented in Table III. On adjusted analysis, there was no significant difference in mortality risk between females (4.7%) and males (3.6%) (sRD 1.2%, $P = 0.25$). Females had a higher risk of bleeding requiring transfusion or procedure (25.2% vs. 17.5%, sRD 7.2%, $P < 0.01$). Males (20.9%) were more likely than females (18.2%) to require a hospital stay greater than 10 days (sRD −5.0%, $P = 0.01$). Females had an increased risk of reoperation (17.0% vs. 0.161, sRD 0.7%, $P = 0.73$), SSI (7.7% vs. 6.4%, sRD 0.6%, $P = 0.65$), pneumonia (6.3% vs. 5.0%, sRD 1.7%, $P = 0.15$), and prolonged ventilation (6.9% vs. 6.0%, sRD 1.4%, $P = 0.32$), though these differences were not statistically significant.

Time Comparison

Patient demographic and preoperative characteristics were stratified by year (2012–2014 vs. 2015–2019). The proportion of preprocedural statin usage increased across time (64.8% in 2012–2014 vs. 69.8% in 2015–2019). Preprocedural beta-blocker usage (53.8% in 2012–2014 vs. 40.3% in 2015–2019) and the proportion of insulin-dependent diabetes (44.2% in 2012–2014 vs. 38.7% in 2015–2019) decreased in later years. Results comparing 30-day postoperative complications in females versus males were also stratified by year (2012–2014 vs. 2015–2019). On adjusted analysis, these results demonstrate that females developed bleeding requiring transfusion or a second procedure at a greater rate than males in both analysis periods (2012–2014 sRD = 11.8%, $P < 0.01$; 2015–2019 sRD = 4.9%, $P = 0.05$). This data also shows that males more frequently required prolonged LOS (>10 days) in the 2015–2019 period (2012–2014 sRD −2.6%, $P = 0.48$ vs. 2015–2019 sRD −6.3%, $P < 0.01$).

American Society of Anesthesiologists Classification and 30-Day Mortality Risk Factors

A detailed breakdown of ASA classification for patients in this study can be seen in Table IV. All patients who died ($n = 76$) had an ASA classification of 3, 4, or 5. In the analysis of 30-day mortality risk factors controlling for gender, bleeding disorders, and smoking, high-risk physiologic factors including claudication, critical limb ischemia, rest pain, and tissue loss were significantly associated with increased risk of death ($P < 0.05$). In addition, our analysis within individuals with preoperative risk factors found no significant differences in 30-day mortality for female compared to male patients (Table V).

Elective versus Nonelective/Emergent Cases

In total, 35 female patients died, among whom 18 had elective surgeries, whereas there were 41 total deaths among male patients, of whom 20 had elective surgeries. On average, having elective surgery was associated with a lower probability of death compared to nonelective/emergent surgery (−5.0%, $P < 0.01$). Female patients who had an elective surgery had a lower probability of death (−5.0%, $P = 0.01$) than their male counterparts (−4.0%, $P < 0.01$). This difference in risk of death for elective surgeries among female compared to male patients was not significant (−9.0%, $P = 0.73$).

DISCUSSION

This retrospective analysis of the NSQIP PUF examined gender disparities in patients undergoing ABFB or ATEA surgery between January 1, 2012 and December 31, 2019. Females were more likely to have underlying COPD and DM, and to have higher preoperative anatomical risk as discussed in the Clinical Characteristics results section. Our findings are consistent with other studies that noted a higher overall prevalence of COPD in females, and a higher prevalence of COPD in female patients undergoing carotid endarterectomy.[14,15]

In our analysis, female patients were at increased risk of postoperative bleeding requiring transfusion or a second procedure, independent of antiplatelet agent usage or underlying bleeding disorders. We were unable to control for anticoagulant therapies, as they were not captured in the NSQIP database; however, other authors have observed similar trends in female patients undergoing revascularization of the lower extremities.[2,12] Furthermore, we noted that female patients undergoing open ABFB or ATAE were more likely to have high-risk anatomical features, to which the increased postoperative risk of bleeding requiring transfusion or a second intervention may be ascribed, given the overall increased complexity of re-do procedures.

Our analysis also revealed that males are at increased risk of prolonged hospitalization greater than 10 days. Evidence examining this trend in the literature is overall sparse; however, a 2012–2014 NSQIP review of patients undergoing aortic reconstruction, lower extremity bypass, lower extremity amputation, and carotid endarterectomy noted that bleeding complications are a key predictor of need for prolonged hospitalization.[16] Interestingly, male patients in our study were less likely to have bleeding complications. This could suggest that other factors associated with prolonged hospitalization, such as cerebrovascular accidents and pneumonia, may serve as better prognostic indicators of need for prolonged hospitalization.[16] It is also important to note that in our analysis, female patients were at increased risk of readmission to the hospital. Although this was not a statistically significant difference, we could infer that the increased readmission rate could be related to the increased risk of bleeding and/or perioperative risk profile, including anatomic risk. These findings warrant future investigation to establish the cause of prolonged hospitalizations in males and higher readmissions among female patients in the NSQIP data.

In spite of a significantly higher rate of preexisting medical conditions (COPD, DM, and high-risk anatomical features), our study found no statistically significant difference in the 30-day mortality risk between female and male patients (4.7% vs. 3.6%, $P = 0.25$). This result does not seem to align with the outcomes of other vascular surgery procedures, including open abdominal aortic aneurysm (AAA) repair, where female patients have been found to have an increased 30-day mortality and overall worse outcomes than male counterparts.[17–19] This dichotomy in results could be ascribed to several factors, such as potentially increased preoperative risk profiles in open AAA repair, or to the fact that AIOD represents a different disease process from AAA. Another plausible explanation is that our study may have been underpowered to detect a mortality difference between male and female patients. A follow-up period greater than 30 days may be necessary to discover a significant mortality difference, as the follow-up period is a documented limitation of the NSQIP database.[20] Alternatively, it is possible that limitations in the dataset itself prevented us from discovering an underlying disparity in mortality. When the results were controlled by elective versus nonelective/emergent status, female patients undergoing elective surgery had a lower probability of death compared to their male counterparts; however, this difference was overall not statistically significant.

The NSQIP database is a validated source which makes it possible to perform large, multicenter studies.[21] Work resulting from this database allows for studies that contribute to the improvement of patient care and allows for investigation of hospital performance in the surgical treatment of a wide variety of diseases.[22,23] Based on results from this analysis, several areas were found that may lack the granularity needed for a more in-depth analysis. Perhaps most importantly, data on race were missing for 26.1% ($n = 488$) of subjects. This is particularly important because racial disparities in surgical outcomes have been demonstrated in the treatment of a wide number of vascular diseases.[24,25] Furthermore, gender reporting is limited to only two genders which may not capture all gender identities.

Another potential area for improvement in patient care stems from observation that the rate of prescribed preprocedure statin and antiplatelet medication was lower than anticipated in both genders. Theoretically, all patients with AIOD requiring operative intervention should be medically managed with both a statin and antiplatelet medication.[26,27] The observed prescription rate was less than 70% for statins and less than 80% for antiplatelet agents, which is well below ideal standards. This suggests that clinicians should emphasize increased preoperative medical optimization, which has also been reported elsewhere in the literature.[28,29] Furthermore, the fact that alternative lipid lowering medications (such as proprotein convertase subtilisin/kexin type 9 inhibitors) and anticoagulants/antiplatelet agents (such as rivaroxaban, apixaban, warfarin, prasugrel) are sometimes used in place of statins and aspirin/clopidogrel suggests that the NSQIP database could benefit from improved reporting on pharmacologic therapy.[28,29] However, it should be noted that these lower than expected prescription rates could also be the result of underreporting.

Our adjusted analysis accounted for ASA status, a validated system that categorizes preoperative surgical risk.[30–32] We found that all patients who died ($n = 76$) in the first 30 postoperative days had a high-risk ASA classification (3, 4, or 5). These patients had a clear high-risk preoperative profile, including nonelective/emergent surgery status.

Limitations to our analysis are also to be noted. Prior surgical intervention (as defined in Clinical Characteristics section) was used as a proxy for anatomical complexity. We acknowledge that this does not fully account for all factors impacting the inherent difficulty and operative risk profile for a surgical procedure: further analysis of anatomical complexity was not possible in this retrospective review of the NSQIP database. It is also important to note that this study is based on data through a 30-day follow-up period, so potential disparities in longer term outcomes cannot be assessed. There are a number of other factors which could also impact our results that cannot be assessed via this retrospective review, including but not limited to surgeon volume, hospital setting (rural versus urban; private versus academic), and each patient's socioeconomic status and access to care. A data collection bias due to the NSQIP database reporting process should also be considered, as discussed above in relation to data on race, gender identity, and pharmacologic therapy (lipid lowering drugs, anticoagulants, and antiplatelet agents).

CONCLUSION

This retrospective study of the NSQIP database found several important gender disparities in patients undergoing ABFB and ATEA surgery between 2012 and 2019. We noted females to have an increased prevalence of preexisting COPD, DM, and high-risk anatomical features.

We also corroborate other findings in the literature that female patients are at increased risk of bleeding complications following surgical intervention for AIOD and propose that this could at least partially be attributed to higher anatomical complexity.

The rate of preprocedural statin and antiplatelet medication prescription has been lower than ideal for both groups, which represents a potential area for clinical improvement. We also report that data on race is missing for 26.1% of patients in this analysis. The NSQIP database data collection process could be further implemented with increased granular data to facilitate more comprehensive and informative comparisons.

Based on these findings and with the limitations previously discussed, we conclude that despite an increased preoperative risk profile, female patients undergoing ABFB and ATEA for AIOD do not have a statistically increased risk of 30-day mortality when compared to male patients. Female patients did experience statistically increased bleeding complications and related additional interventions. Analysis of long-term outcomes, in terms of 1-year mortality and limb salvage may be needed in order to further assess gender disparities in outcomes of ABFB and ATEA for AIOD. Future studies could then seek to create protocols for alleviating observed disparities in this patient population, most of which negatively impacts female patients.

Acknowledgments

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors would like to thank Rebecca Carlson, MLS, AHIP for her assistance gathering resources during the literature review for this project.

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Table I.

Distribution of patient and surgical characteristics among adults with aortoiliac occlusive disease undergoing aortobifemoral bypass surgery between 2012 and 2019

Characteristics	Overall *n* = 1,869	Female *n* = 743	Male *n* = 1,126
Sex, *n* (%)			
Female	743 (39.8)	743 (100.0)	–
Male	1,126 (60.2)	–	1,126 (100.0)
Age, median (IQR)	61 (56–68)	62 (56–69)	61 (56–67)
Age category, *n* (%)			
30–39	15 (0.8)	9 (1.2)	6 (0.5)
40–49	130 (7.0)	59 (7.9)	71 (6.3)
50–59	620 (33.2)	214 (28.8)	406 (36.1)
60–69	749 (40.1)	276 (37.1)	473 (42.0)
70–79	327 (17.5)	168 (22.6)	159 (14.1)
80+	25 (1.3)	15 (2.0)	10 (0.9)
Race, *n* (%)			
White	1,209 (87.5)	479 (86.0)	730 (88.6)
Black	162 (11.7)	73 (13.1)	89 (10.8)
Other	10 (0.7)	5 (0.9)	5 (0.6)
Missing	488	186	302
BMI, *n* (%)			
Underweight (<18.5)	99 (5.5)	49 (6.9)	50 (4.6)
Normal (18.5 to <25)	696 (38.7)	246 (34.6)	450 (41.4)
Overweight (25 to <30)	611 (34.0)	240 (33.8)	371 (34.1)
Obese (30 to <35)	285 (15.8)	115 (16.2)	170 (15.6)
Very obese (35+)	108 (6.0)	61 (8.6)	47 (4.3)
Missing	70	32	38
Year of operation, *n* (%)			
2012	71 (3.8)	29 (3.9)	42 (3.7)
2013	275 (14.7)	123 (16.6)	152 (13.5)

Characteristics	Overall *n* = 1,869	Female *n* = 743	Male *n* = 1,126
2014	252 (13.5)	100 (13.5)	152 (13.5)
2015	265 (14.2)	110 (14.8)	155 (13.8)
2016	273 (14.6)	97 (13.1)	176 (15.6)
2017	255 (13.6)	91 (12.2)	164 (14.6)
2018	235 (12.6)	99 (13.3)	136 (12.1)
2019	243 (13.0)	94 (12.7)	149 (13.2)
Elective surgery, *n* (%)			
Yes	1,368 (73.2)	547 (73.6)	821 (73.0)
No	500 (26.8)	196 (26.4)	304 (27.0)
Comorbidities, *n* (%)			
Congestive heart failure	16 (0.9)	7 (0.9)	9 (0.8)
Severe COPD	321 (17.2)	155 (20.9)	166 (14.7)
Hypertension requiring medication	1,318 (70.5)	535 (72.0)	783 (69.5)
Smoking	1,371 (73.4)	543 (73.1)	828 (73.5)
Cancer	5 (0.3)	1 (0.1)	4 (0.4)
Diabetes	408 (21.8)	189 (25.4)	219 (19.4)
Insulin-requiring	165 (40.4)	73 (38.6)	92 (42.0)
Not insulin-requiring	243 (59.6)	116 (61.4)	127 (58.0)
Bleeding conditions	231 (12.4)	91 (12.2)	140 (12.4)
Preprocedural medications, *n* (%)			
Statin	1,269 (68.2)	514 (69.5)	755 (67.4)
Aspirin/clopidogrel	1,426 (76.7)	551 (74.7)	875 (78.0)
Beta-blocker	828 (44.6)	324 (43.9)	504 (45.1)
Functional status, *n* (%)			
Independent	1,815 (97.3)	718 (96.9)	1,097 (97.5)
Partially or fully dependent	51 (2.7)	23 (3.1)	28 (2.5)
Wound classification, *n* (%)			
Clean	1,809 (96.8)	717 (96.5)	1,092 (97.0)
Clean/contaminated	34 (1.8)	15 (2.0)	19 (1.7)

Characteristics	Overall *n* = 1,869	Female *n* = 743	Male *n* = 1,126
Contaminated or dirty/infected	26 (1.4)	11 (1.5)	15 (1.3)
ASA classification, *n* (%)			
1 or 2	55 (2.9)	16 (2.2)	39 (3.5)
3, 4, or 5	1,814 (97.1)	727 (97.8)	1,087 (96.5)
Symptoms, *n* (%)			
Claudication	898 (48.8)	337 (46.2)	561 (50.4)
Critical limb ischemia	875 (47.5)	364 (49.9)	511 (46.0)
Asymptomatic	68 (3.7)	28 (3.8)	40 (3.6)
Missing	28	14	14
High risk, physiologic, *n* (%)	101 (5.4)	41 (5.6)	60 (5.4)
Missing	15	6	9
High risk, anatomic, *n* (%)	672 (36.0)	293 (39.4)	379 (337)

ASA, American Society of Anesthesiologists; BMI, body mass index; COPD, chronic obstructive pulmonary disease; IQR, interquartile range.

Table II.

Detailed comparison of ASA classification, comorbidities, functional status, high-risk factors, and symptoms between genders

	Female			Male					
Risk factor	**Count**	**Prevalence**	**(95% CI)**	**Count**	**Prevalence**	**(95% CI)**	**Prevalence difference**	**(95% CI)**	***P*-value**
ASA classification									
Low-risk ASA (1 or 2)	16	0.02	(0.01–0.03)	39	0.03	(0.02–0.05)	−0.01	(−0.03 to 0.00)	0.09
Comorbidities									
Bleeding disorders	91	0.12	(0.10–0.15)	140	0.12	(0.11–0.14)	0.00	(−0.03 to 0.03)	0.90
CHF	7	0.01	(0.00–0.00)	9	0.01	(0.00–0.01)	0.00	(−0.00 to 0.01)	0.75
COPD	155	0.21	(0.18–0.24)	166	0.15	(0.13–0.17)	**0.061**	**(0.03–0.10)**	**< 0.01**
Hypertension	535	0.72	(0.69–0.75)	783	0.70	(0.67–0.72)	0.02	(−0.02 to 0.07)	0.25
Smoking	543	0.73	(0.70–0.76)	828	0.74	(0.71–0.76)	0.00	(−0.05 to 0.04)	0.83
Cancer	1	0.00	(−0.00 to 0.00)	4	0.00	(0.00–0.01)	0.00	(−0.01 to 0.00)	0.32
Diabetes mellitus	189	0.25	(0.22–0.29)	219	0.19	(0.17–0.22)	**0.060**	**(0.02–0.10)**	**< 0.01**
Functional status									
Independent	718	0.97	(0.96–0.98)	1,097	0.98	(0.97–0.98)	−0.01	(−0.02 to 0.01)	0.44
High-risk factors									
Anatomic (prior abdominal surgery, prior ipsilateral bypass involving currently treated segment, prior ipsilateral percutaneous intervention involving currently treated segment)	293	0.394	(0.36–0.43)	379	0.337	(0.31–0.36)	**0.058**	**(0.01–0.10)**	**0.01**
Physiologic	41	0.06	(0.04–0.07)	60	0.05	(0.04–0.07)	0.00	(−0.02 to 0.02)	0.86
Symptoms									
Asymptomatic	365	0.50	(0.46–0.54)	601	0.54	(0.51–0.57)	−0.04	(−0.09 to 0.01)	0.09

Bolded values represent those with statistical significance.

ASA, American Society of Anesthesiologists; CHF, congestive heart failure; CI, confidence interval; COPD, chronic obstructive pulmonary disease.

Table III.

Differences in 30-day risk (incidence) of mortality and surgical complications between female and male patients with aortoiliac occlusive disease undergoing aortobifemoral bypass surgery between 2012 and 2019

	Female			Male			Crude[a]			Standardized[b]		
Outcome	**No. of events**	**Risk**	**(95% CI)**	**No. of events**	**Risk**	**(95% CI)**	**RD**	**(95% CI)**	***P*-value**	**sRD[a]**	**(95% CI)**	***P*-value**
Mortality	35	0.047	(0.03–0.06)	41	0.036	(0.03–0.05)	0.011	(−0.01 to 0.03)	0.26	0.012	(−0.01 to 0.03)	0.25
Surgical complication												
Bleeding requiring transfusion or procedure	187	0.252	(0.22–0.28)	197	0.175	(0.15–0.20)	**0.077**	**(0.04–0.11)**	**< 0.01**	**0.072**	**(0.03–0.11)**	**< 0.01**
Prolonged LOS (>10 days)	135	0.182	(0.15–0.21)	235	0.209	(0.19–0.23)	−0.027	(−0.06 to 0.01)	0.15	**−0.050**	**(−0.09 to −0.01)**	**0.01**
Reoperation	126	0.170	(0.14–0.20)	181	0.161	(0.14–0.18)	0.009	(−0.03 to 0.04)	0.62	0.007	(−0.03 to 0.04)	0.73
Readmission	83	0.112	(0.09–0.13)	91	0.081	(0.06–0.10)	**0.031**	**(0.00–0.06)**	**0.03**	0.023	(−0.01 to 0.05)	0.12
Surgical site infection	57	0.077	(0.06–0.10)	72	0.064	(0.05–0.08)	0.013	(−0.01 to 0.04)	0.29	0.006	(−0.02 to 0.03)	0.65
Prolonged ventilation	51	0.069	(0.05–0.09)	67	0.060	(0.05–0.07)	0.009	(−0.01 to 0.03)	0.43	0.014	(−0.01 to 0.04)	0.32
Pneumonia	47	0.063	(0.05–0.08)	56	0.050	(0.04–0.06)	0.014	(−0.01 to 0.04)	0.22	0.017	(−0.01 to 0.04)	0.15
MI/stroke	35	0.047	(0.03–0.06)	57	0.051	(0.04–0.06)	−0.004	(−0.02 to 0.02)	0.72	0.000	(−0.02 to 0.02)	0.99
Renal failure	18	0.024	(0.01–0.04)	37	0.033	(0.02–0.04)	−0.009	(−0.02 to 0.01)	0.27	−0.004	(−0.02 to 0.02)	0.72
Wound disruption	13	0.017	(0.01–0.03)	26	0.023	(0.01–0.03)	−0.006	(−0.02 to 0.01)	0.39	−0.010	(−0.02 to 0.00)	0.17
Pulmonary embolism or vein thrombosis	9	0.012	(0.00–0.02)	16	0.014	(0.01–0.02)	−0.002	(−0.01 to 0.01)	0.69	−0.002	(−0.01 to 0.01)	0.76
Amputation	7	0.010	(0.00–0.02)	11	0.010	(0.00–0.02)	0.000	(−0.01 to 0.01)	0.92	−0.004	(−0.01 to 0.00)	0.37

Bolded values represent those with statistical significance.

ASA, American Society of Anesthesiologists; BMI, body mass index; CHF, congestive heart failure; CI, confidence interval; COPD, chronic obstructive pulmonary disease; LOS, length of stay; MI, myocardial infarction; RD, risk difference; sRD, standardized risk difference.

[a] Risk differences comparing the 30-day incidence between female and male patients (i.e., risk in females minus risk in males). 95% CIs were estimated using a binomial regression model. *P*-value estimated using a Wald chi-squared test.

[b] Analyses were conducted in weighted population using inverse probability weighting. Weights were estimated using a logistic regression model with gender as the dependent variable and the patient and surgical characteristics as independent variables. The model included age (modeled as quadratic spline), year of operation, elective surgery, BMI (categorical), comorbidities (CHF, COPD, hypertension, smoking, cancer, diabetes), functional independence, ASA classification, symptoms, and physical and anatomic risk status. Race was not included in the model due to large amounts of missing data. Stabilized weights for each individual were calculated as the marginal prevalence of the individual's gender divided by the conditional prevalence of the individual's gender. Standardized risks and risk differences were estimated using a binomial regression model weighted using the gender weights.

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Table IV.

Detailed breakdown of ASA classification among patients in this study

ASA classification	Frequency	Percent
1: Healthy patient	2	0.11
2: Mild systemic disease	53	2.84
3: Severe systemic disease that is a constant threat to life	1,141	61.05
4: Incapacitating disease that is a constant threat to life	653	34.94
5: Moribund patient who is not expected to live 24 hr with or without surgery	20	1.07
Total	1,869	100

ASA, American Society of Anesthesiologists.

Table V.

Associations between preoperative risk factors and 30-day risk of death controlling for patient sex among n = 1,869 participants in NSQIP data between 2012 and 2019; total deaths = 76

Definition	No. of deaths among those with risk factor			No. of death events among those without risk factor	Risk difference comparing those with risk factor versus those without risk factor	(95% CI)	*P*-value
	Full sample	Female	Male				
ASA classification							
High-risk ASA classification (ASA 3, 4, or 5)	76	35	41	0	0.06	(−0.20 to 0.32)	0.66
Comorbidities							
Bleeding disorders	18	8	10	58	**−0.04**	**(−0.08 to −0.01)**	**0.02**
CHF	3	3	0	73	−0.14	(−0.34 to 0.05)	0.14
COPD	20	12	8	56	−0.02	(−0.05 to 0.00)	0.09
Hypertension	57	28	29	19	−0.01	(−0.03 to 0.01)	0.43
Smoking	42	17	25	34	**0.04**	**(0.01–0.06)**	**0.00**
Cancer	1	1	0	75	−0.16	(−0.51 to 0.20)	0.39
Diabetes	14	8	6	62	0.01	(−0.01 to 0.03)	0.36
Functional status							
Independent	72	33	39	4	0.04	(−0.04 to 0.11)	0.32
High-risk factors							
Anatomic (prior abdominal surgery, prior ipsilateral bypass involving currently treated segment, or prior ipsilateral percutaneous intervention involving currently treated segment)	33	17	16	43	−0.01	(−0.03 to 0.01)	0.22
Physiologic	15	8	7	58	**−0.11**	**(−0.18 to −0.04)**	**0.00**
Symptoms							
Symptoms (claudication, critical limb ischemia: rest pain and tissue loss)	62	28	34	42	**0.1105**	**(0.03–0.20)**	**0.01**

All models for risk estimates have been adjusted for gender.

Bolded values represent those with statistical significance.

ASA, American Society of Anesthesiologists; CHF, congestive heart failure; CI, confidence interval; COPD, chronic obstructive pulmonary disease; NSQIP, National Surgical Quality Improvement Program.