Letters

RESEARCH LETTER

COVID-19: BEYOND TOMORROW

US National Trends in Vascular Surgical Practice During the COVID-19 Pandemic

Multicenter reports suggest that emergency coronary and cerebral revascularizations have decreased in the US during the COVID-19 pandemic, prompting concerns about unmet cardiovascular care needs.[1-3] This study sought to quantify national trends in vascular surgical practice during the COVID-19 pandemic.

Methods | Monthly volumes for aortic interventions, carotid interventions, and lower extremity interventions (LEIs) from June 2018 to June 2020 were queried from the Vascular Quality Initiative, a prospectively maintained national database. The study was approved by the Stanford University institutional review board with a waiver of consent (because of the retrospective review of deidentified data) and followed STROBE guidelines for observational studies. Of 620 centers, 206 were included for continuous participation. We compared monthly procedure rates by urgency in a pandemic cohort (January 2020 through June 2020) with a historical cohort (January 2019 through June 2019) using χ^2 and *t* tests. Data analysis was completed with Pycharm version 2020.1.4 (JetBrains). A significant threshold of $P < .05$ was used for 2-tailed tests.

Results | The pandemic cohort included 24 979 procedures: 14 292 LEIs (57.2%), 7475 carotid interventions (29.9%), and 3212 aortic interventions (12.9%). Patients treated during the pandemic were more likely to use Medicare as a primary insurer (carotid interventions: pandemic, 4783 [64.2%] vs historical, 5198 [53.4%]; aortic interventions: pandemic, 2070 [64.4%] vs historical, 2459 [54.4%]; LEIs: pandemic, 8422 [58.9%] vs historical, 8830 [49.8%]; all $P < .001$) (**Table**). In the LEI cohort, patients treated during the pan-

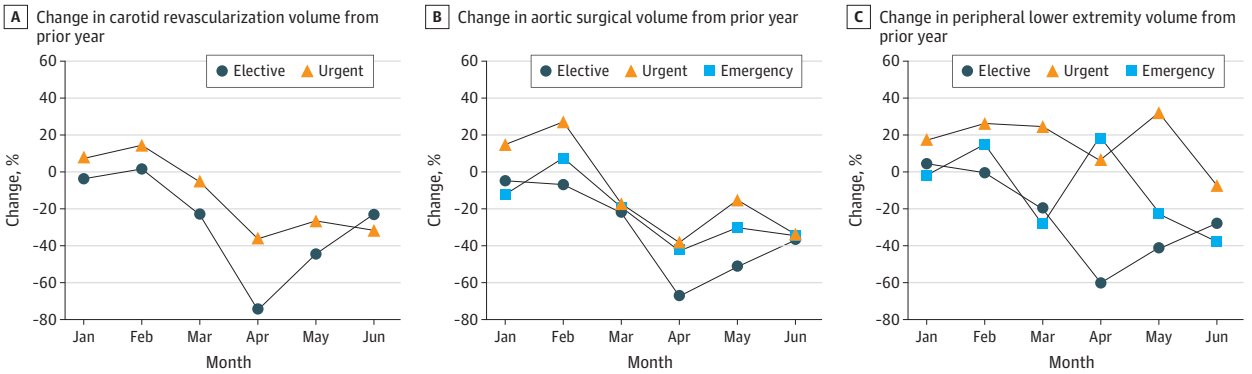
Table. Comparison of Historical Cohort (January 2019-June 2019) and Pandemic Cohort (January 2020-June 2020) by Urgency

	Carotid intervention[a]			Aortic intervention			Lower extremity intervention		
Characteristic	Pandemic	Historical	*P* value	Pandemic	Historical	*P* value	Pandemic	Historical	*P* value
No.	7475	9747	NA	3212	4521	NA	14 292	17 716	NA
Urgency									
Emergency	3319 (44.4)	3863 (39.6)		330 (10.3)	427 (9.4)		330 (2.3)	371 (2.1)	
Urgent	NA	NA	<.001	420 (13.1)	477 (10.5)	.008	2692 (18.8)	2325 (13.1)	<.001
Elective	4156 (55.6)	5884 (61.4)		2462 (76.6)	3617 (80.0)		11 270 (78.8)	15 020 (84.8)	
Age, mean (SD), y	70.7 (9.6)	70.6 (9.6)	.62	70.9 (11.3)	71.4 (10.7)	.03	68.2 (11.2)	68.2 (11.1)	.65
Female	2762 (36.9)	3628 (37.2)	.73	827 (25.7)	1086 (24.0)	.10	5371 (37.5)	6713 (37.9)	.51
BMI, mean (SD)	28.6 (5.8)	28.6 (5.9)	.74	28.1 (6.4)	28.1 (6.3)	.96	27.7 (6.2)	27.8 (6.2)	.03
Primary insurer									
Medicare	4783 (64.2)	5198 (53.4)		2070 (64.4)	2459 (54.4)		8422 (58.9)	8830 (49.8)	
Medicaid	285 (3.8)	404 (4.1)		158 (4.9)	174 (3.8)		1195 (8.4)	1397 (7.9)	
Commercial	2136 (28.7)	3867 (39.7)	<.001	860 (26.8)	1709 (37.8)	<.001	3767 (26.4)	6668 (37.6)	<.001
Military/Veterans Affairs	133 (1.8)	134 (1.4)		62 (1.9)	80 (1.8)		237 (1.7)	232 (1.3)	
Non-US	6	3		1	1		1	2	
Self-pay	109 (1.5)	133 (1.4)		59 (1.8)	96 (2.1)		268 (1.9)	290 (1.6)	
Transferred	755 (10.1)	857 (8.8)	.003	530 (16.5)	696(15.4)	NA	341 (11.8)	323 (8.7)	NA
Residential status									
Home	7379 (98.7)	9619 (98.7)		3178 (98.9)	4477 (99.0)		13 219 (92.4)	16 650 (94.0)	
Nursing home	87 (1.2)	118 (1.2)	.92	30 (0.9)	34 (0.8)	.65	553 (3.9)	684 (3.9)	.41
Homeless	8 (0.1)	9		4 (0.1)	7 (0.2)		55 (0.4)	54 (0.3)	
Coronary artery disease	2555 (34.2)	3176 (32.6)	.03	810 (25.2)	1155 (25.6)	.74	4144 (34.3)	5330 (47.9)	<.001
Congestive heart failure	1014 (13.6)	1297 (13.3)	.62	408 (12.7)	583 (12.9)	.79	3334 (23.3)	3654 (20.6)	<.001
Chronic obstructive pulmonary disease	1709 (22.9)	2441 (25.0)	.25	1085 (33.8)	1518 (33.6)	.86	4030 (28.2)	5040 (28.5)	.64
Diabetes	1741 (36.0)	2485 (37.2)	.001	590 (18.4)	874 (19.4)	.28	7805 (87.6)	9441 (86.8)	.12
Dialysis	104 (2.1)	118 (1.8)	.14	56 (12.2)	82 (13.4)	.57	1428 (10.5)	1633 (9.7)	.02
Hypertension	6677 (89.4)	8762 (90)	.22	2702 (85.0)	3815 (84.8)	.82	12 573 (88.9)	15 613 (88.3)	.08
Smoking history	5458 (73.1)	7197 (73.8)	.23	2656 (82.8)	3801 (84.3)	.08	11 294 (79.1)	14 229 (80.3)	.006
Statin	6826 (91.4)	8803 (90.3)	.02	2309 (72.0)	3171 (70.4)	.13	11 657 (81.6)	14 263 (80.5)	.02
$P2Y_{12}$ inhibitor use	4293 (57.4)	5253 (53.9)	<.001	474 (14.8)	651 (14.5)	.71	6351 (44.4)	7767 (43.9)	.30
Anticoagulation	1013 (13.6)	1359 (13.9)	.46	488 (15.2)	691 (15.3)	.91	3459 (24.1)	3825 (21.6)	<.001

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); NA, not applicable.

[a] Carotid revascularizations were categorized as urgent or elective.

Figure. Percentage Difference in Monthly National Surgical Volumes From January to June 2020, Compared With the Year Prior



demic were more likely to be transferred (pandemic, 341 [11.8%] vs historical, 323 [8.7%]) and have a history of congestive heart failure (pandemic, 3334 [23.3%] vs historical, 3654 [20.6%]; $P < .001$), dialysis (pandemic, 1428 [10.5%] vs historical, 1633 [9.7%]; $P = .02$), or anticoagulation (pandemic, 3459 [24.1%] vs historical, 3825 [21.6%]; $P < .001$).

Pandemic-period elective LEI volumes fell by 20.3% (before the pandemic, 2442 procedures; during the pandemic, 1945 procedures) to 60.0% (before, 2590; during, 1036) from March to June 2020 ($P < .001$), while emergency LEIs increased by 18.6% (before, 53; during, 63) in April 2020 ($P = .03$) and urgent LEI volumes increased by 20.3% (before, 364; during, 452) and 32.4% (before, 392; during, 519) in March and May 2020, respectively ($P < .001$). Conversely, pandemic-period carotid procedures demonstrated statistically significant decline across elective procedures (April: before, 1071; during, 263; decline, 75.4%; May: before, 1027; during, 556; decline, 45.8%; June: before, 943; during, 732; decline, 22.3%; $P < .001$) and urgent procedures (March: before, 626; during, 594; decline, 5.1%; April: before, 660; during, 423; decline, 35.9%; May: before, 684; during, 503; decline, 26.5%; June: before, 679; before, 461; decline, 32.1%; $P < .001$). Aortic procedures declined significantly across elective indications (March: before, 598; during, 463; decline, 22.5%; $P = .04$; April: before, 596; during, 191; decline, 68.0%; May: before, 666; during, 324; decline, 51.4%; June: before, 561; during, 358; decline, 36.2%; $P < .001$ for April through June), urgent indications (March: before, 77; during, 65; decline, 17.7%; $P = .01$; April: before, 81; during, 55; decline, 38.8%; $P = .01$; May: before, 101; during, 86; decline, 14.9%; June: before, 62; during, 40; decline, 36.1% decline; $P < .001$ for May and June), and emergency indications (May: before, 63; during, 44; decline, 30.1%; June: before, 63; during, 41; decline, 34.8%; $P < .001$) (**Figure**).

Discussion | Compared with historical volumes, urgent and emergency LEIs increased in March, April, and May 2020 as the COVID-19 pandemic surged in the US. Possible causes for increased urgent and emergency LEIs include COVID-19 infection, which has been associated with thrombotic complications, including lower extremity ischemia. Additionally, delayed care may contribute to urgent or emergency LEIs. In a national survey from the National Center for Health Statistics from April to July 2020, 38.7% to 41.5% of households reported a delay in medical care in the prior month because of COVID-19. In Italy and the Netherlands, a reduction in elective LEIs during the pandemic was associated with patients presenting with higher peripheral artery disease severity and increased rates of major amputations.[4,5] That patients treated during the pandemic in this analysis were more likely to have severe comorbidities and be transferred from another institution may indicate a shift toward treating those in more dire medical states than in the prepandemic period.

While declines in elective procedures were expected, concurrent declines in urgent and emergency aortic and carotid interventions throughout the study period were not expected. Because the pandemic is unlikely to reduce incidence of aortic rupture or symptomatic carotid disease, this is more likely because to reduced access to care. Aortic rupture in particular is a time-sensitive condition with significant prehospital mortality, and the additional burden of COVID-19 may hinder expedient transfer and resuscitation efforts, causing excess deaths. Indeed, national reports have identified that 34% of excess deaths during the pandemic cannot be attributed to COVID-19 alone.[6]

Limitations. Study limitations include the retrospective observational approach, which prohibits the determination of causality. Variables such as surgical urgency were clinician reported and thus vulnerable to error. Additionally, the COVID-19 status of patients is unknown. Reduced surgical volumes could be confounded by reduced reporting during quarantine, although this would be expected to negatively affect urgent and emergency volumes, where an increase was actually observed for LEIs.

Conclusions | While elective and emergency interventions for aortic and carotid disease decreased throughout the COVID-19 pandemic, nonelective revascularization for acute limb ischemia increased in March to May 2020. Future research should examine potential adverse effects of these trends.

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