Intentional left subclavian artery coverage during thoracic endovascular aortic repair for traumatic aortic injury

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Background: Thoracic endovascular aortic repair (TEVAR) is widely used for treatment of traumatic aortic injury (TAI). Stent graft coverage of the left subclavian artery (LSA) may be required in up to 40% of patients. We evaluated the long-term effects of intentional LSA coverage (LSAC) on symptoms and return to normal activity in TAI patients compared with a similarly treated group whose LSA was uncovered (LSAU).

Methods: Patients were identified from a prospective institutional trauma registry between September 2005 and July 2012. TAI was confirmed using computed tomography angiography. The electronic medical records, angiograms, and computed tomography angiograms were reviewed in a retrospective fashion. In-person or telephone interviews were conducted using the SF-12v2 (Quality Metrics, Lincoln, RI) to assess quality of life. An additional questionnaire was used to assess specific LSA symptoms and the ability to return to normal activities. Data were analyzed by Spearman rank correlation and multiple linear and logistic regression analysis with appropriate transformations using SAS software (SAS Institute, Cary, NC).

Results: During the study period, 82 patients (57 men; mean age 40.5 ± 20 years, mean Injury Severity Score, 34 ± 10.0) underwent TEVAR for treatment of TAI. Among them, LSAC was used in 32 (39.5%) and LSAU in 50. A group of the LSAU patients (n = 22) served as matched controls in the analysis. We found no statistically significant difference in SF-12v2 physical health scores ($\rho = -0.08$; $P = .62$) between LSAC and LSAU patients. LSAC patients had slightly better mental health scores ($\rho = 0.62$; $P = .037$) than LSAU patients. LSAC patients did not have an increased likelihood of experiencing pain ($\rho = -0.0056$; $P = .97$), numbness ($\rho = -0.12$; $P = .45$), paresthesia ($\rho = -0.11$; $P = .48$), fatigue ($\rho = -0.066$; $P = .69$), or cramping ($\rho = -0.12$; $P = .45$). We found no difference between groups in the ability to return to activities. The mean follow-up time was 3.35 years. Six LSAC patients (19%) died during the follow-up period of unrelated causes.

Conclusions: Intentional LSAC during TEVAR for TAI appears safe, without compromising mental or physical health outcomes. Furthermore, LSAC does not increase the long-term risk of upper extremity symptoms or impairment of normal activities. (J Vasc Surg 2015;61:73-9.)

Traumatic aortic injury (TAI) is the second most common cause of death after blunt trauma, surpassed only by head injuries.[1,2] Thoracic endovascular aortic repair (TEVAR) has become the treatment of choice for anatomically suitable patients with TAI because meta-analyses have demonstrated that it results in less mortality, paraplegia, stroke, and spinal cord ischemia (SCI) compared with open repair.[3,4] The most common location for blunt aortic injury is at the isthmus, and left subclavian artery coverage (LSAC) is required in up to 40% of patients.[5,6]

There is a paucity of data addressing the long-term outcomes of patients requiring LSAC during TEVAR for TAI. The necessity of left subclavian artery revascularization is debated in the literature. The current Society for Vascular Surgery (SVS) Clinical Practice Guidelines suggest selective revascularization as an appropriate treatment strategy for patients undergoing TEVAR for TAI.[7] However, there is a growing body of evidence that revascularization may be beneficial in patients undergoing LSAC for aneurysmal disease. Whether these data extrapolate to TAI patients is unclear. The present study was performed to evaluate the long-term outcomes of intentional LSAC in patients with TAI who undergo TEVAR.

METHODS

The Committee for the Protection of Human Subjects, the local Institutional Review Board, approved this study with a waiver of consent. Data on patients with TAI who underwent TEVAR were prospectively collected from the institutional trauma registry at our level 1 trauma center between September 2005 and July 2012.
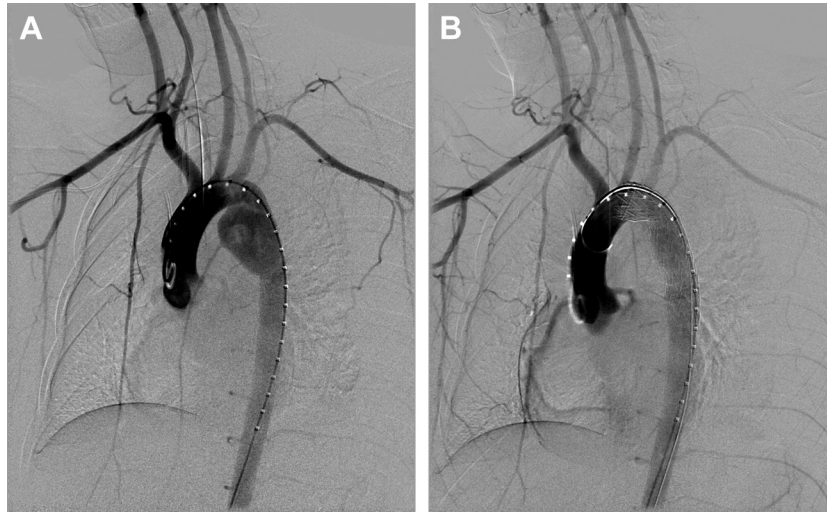
Fig 1. A, Diagnostic and **(B)** completion angiogram of a patient who underwent thoracic endovascular aortic repair (TEVAR) with left subclavian artery coverage (LSAC) for traumatic aortic injury (TAI).

In 2005, the Thoracic Aortic Graft (TAG; W. L. Gore & Associates, Flagstaff, Ariz) was approved by the United States Food and Drug Administration (FDA) for repair of thoracic aortic aneurysms. We started performing TEVAR for patients with TAI with the off-label use of the TAG device. Owing to available device diameter limitations, the TEVAR procedure could only be offered to patients with aortic diameters >23 mm. Two smaller devices, Talent (Medtronic, Santa Rosa, Calif) and TX2 (Cook Medical, Bloomington, Ind), were approved in 2008, facilitating the treatment of patients with smaller aortic diameter in an off-label fashion. The Food and Drug Administration subsequently approved the CTAG (W. L. Gore) and Valiant (Medtronic) devices for on-label use of isolated lesions, including TAI, in 2012.

Our treatment algorithm has been previously described.[6] TAI cases were identified using computed tomography angiography (CTA) and grouped into one of four grades by severity. Grade I is characterized by an intimal tear, with no involvement of the media and no contour abnormalities to the outside surface of the aorta. Grade II is an injury that extends to the media, such as an intramural hematoma or dissection, with the presence of an external contour abnormality. Grade III is an aortic pseudoaneurysm, and grade IV is free rupture.[6] Grade I injuries were managed medically with anti-impulse therapy using β-blockers and a follow-up CTA in 6 weeks to ensure healing of the lesion. Grades II and III were considered for urgent repair with TEVAR. Grade IV underwent emergency repair.

We tailored the timing of repair to each patient by the grade of the aortic injury, the presence and severity of associated injuries, and the patient's overall physiologic status. In general, urgent TEVAR for stable grade II and III patients was done within 24 to 48 hours of admission. Patients with grade IV injuries were taken directly to the operating room from the emergency department for

emergency repair. In addition, patients with traumatic brain injury required more immediate intervention because they are not suitable candidates for anti-impulse therapy.

LSAC was used where necessary to achieve a 20 mm proximal seal zone, as recommended by the manufacturer's instructions for use. Patients who were not anatomically suitable for TEVAR underwent open repair and were not a part of our present analysis. Contraindications to TEVAR would include injuries that involve the ascending aorta or transverse arch, anatomy that is prohibitive for device delivery, and allergies to device components.

TEVAR procedures were performed in a hybrid operating room equipped with fixed imaging equipment (Axiom; Siemens Medical, Malvern, Pa). Patients were under general anesthesia with the abdomen and bilateral groins prepared. An arch angiogram was performed before the procedure to further delineate the injury and evaluate cerebrovascular anatomy (Fig 1, *A*). Patients were anticoagulated with heparin using a weight-based protocol (1 mg/kg) or a smaller dose of 3000 to 5000 units. Patients with associated injuries who were at high risk of bleeding, such as those with intracranial hemorrhage or solid organ injury, received the smaller dose of heparin.

The device was delivered and deployed without pharmacologic adjunct. A postdeployment arch angiogram was performed (Fig 1, *B*). Balloon angioplasty was performed selectively if a type I endoleak was apparent. We maintained a policy of selective delayed subclavian artery revascularization. Patients were returned to the intensive care unit after TEVAR and were discharged after other injuries they incurred were stabilized. Follow-up CTAs were performed at 1, 6, and 12 months, and yearly thereafter to exclude complications.

For the purpose of the quality of life study, patients were grouped into two treatment arms: those who required LSAC and those whose LSA was uncovered (LSAU). A group of matched controls, according to the Injury Severity Score

Table. Baseline characteristics for patients included in the study

| Parameter | Mean for | | | P |
	LSAC	LSAU	All surveyed	
Age, years	53.69 ± 22.3	36.77 ± 16.6	46.7 ± 21.7	<.004
ISS	32.3 ± 9	36.8 ± 10.7	34.3 ± 9.8	.13
GCS	10.0 ± 5.5	10.4 ± 5.4	10.2 ± 5.4	.95
RPS	0.71 ± 0.27	0.76 ± 0.29	0.73 ± 0.28	.53
TAI grade[a] (IQR)	3 (3-3)	3 (2-3)	3 (3-3)	.52
Device diameter, mm[a] (IQR)	26 (22-28)	25 (22-26)	25 (22-28)	.16
Length of stay, days				
Intensive care unit	14.24 ± 12.9	13.86 ± 16.5	14.08 ± 14.4	.49
Total hospital	22.6 ± 21.4	23.8 ± 19.4	23.2 ± 20.4	.82
Time since TEVAR, years	3.23 ± 2.1	3.67 ± 2.44	3.46 ± 2.2	.32

GCS, Glasgow Coma Scale; *IQR,* interquartile range; *ISS,* Injury Severity Score; *LSAC,* left subclavian artery coverage; *LSAU,* left subclavian artery uncovered; *RPS,* Revised Probability of Survival; *TAI,* traumatic aortic injury; *TEVAR,* thoracic endovascular aortic repair.
[a]Median reported.

(ISS), Glasgow Coma Scale (GCS), Revised Probability of Survival (RPS), and TAI grade, were selected from the LSAU arm to ensure comparability of the two groups. In-person or telephone interviews were conducted using the SF-12v2 instrument (Quality Metrics, Lincoln, RI) to assess quality of life. The physical and mental health scores generated by the SF-12v2 were both used in our analysis.

An additional survey was conducted concerning incidence of symptoms and ability to return to normal activities in the postoperative period. Patients were asked if they experienced paresthesia, numbness, tingling, pain, cramping, or weakness in the left arm in excess of the right to screen for symptoms related to LSAC. If symptoms were present, patients indicated the duration that symptoms lasted in the postoperative period. In addition, patients were asked about their normal activities before TEVAR and whether they felt they were impaired in their performance of those activities after the procedure. If impairment was present, patients were asked to rate their level of impairment on a graded scale.

For the LSAC group, perioperative CTAs were reviewed to measure bilateral vertebral artery size to assess predictive value for presence and duration of symptoms. Patients with right vertebral arteries (RVAs) with greater diameter than the left were said to be RVA dominant, and the size of the RVA in excess of the left vertebral artery (LVA) was used in our analysis. During an in-office follow-up visit, wrist-brachial indices were performed to measure a relationship among a reduction in segmental pressures with symptoms, activity impairment, and quality of life.

Data were analyzed by Spearman rank correlation and multiple linear and logistic regression analysis with appropriate transformations using SAS 9.3 software (SAS Institute, Cary, NC).

RESULTS

During the study period, 82 patients (57 men; mean age, 40.5 ± 20 years; mean ISS, 34 ± 10.0) underwent TEVAR for TAI. Among them, 32 (39.5%) required LSAC. A group of 22 LSAU patients served as matched

(ISS, GCS, RPS, and TAI grade) controls. For the 54 patients included in this analysis, ISS, GCS, TAI grade, device diameter, intensive care unit length of stay, and total hospital length of stay are provided in the Table. The midterm outcomes of this cohort have been previously published.[5] Six of the LSAC patients expired during the follow-up period. We were able to contact 18 of the remaining 26 patients. Eight patients (31%) were lost to follow-up.

We found no statistically significant difference in the SF-12v2 physical health scores between LSAC and LSAU patients ($\rho = -0.08$; $P = .62$). The LSAC patients had slightly better mental health scores on the SF-12v2 ($\rho = .62$; $P = .037$). As expected, impairment of activities and presence of symptoms were both negatively correlated with SF-12v2 physical and mental health scores, as characterized in the Supplementary Table (online only). We could identify no statistically significant difference in the ability to return to normal activities or in the incidence of postoperative symptoms between LSAC and LSAU patients, as displayed in Figs 2 and 3, respectively. Mean telephone interview follow-up time was 3.46 years (standard deviation, 1.9 years) for the entire cohort.

Three of the 18 patients (17%) in the LSAC group were left-handed, whereas only one of the 22 patients (4.5%) in the LSAU group was left-handed. Vertebral artery measurements from intraoperative arch angiograms showed increasing RVA dominance was negatively correlated with the incidence of numbness ($\rho = -0.62$; $P = .02$). No association was found among a reduction in peak systolic velocity and SF-12v2 scores, symptoms, or impairment of activities.

Two carotid-subclavian bypasses were performed for reflex sympathetic dystrophy and atherosclerotic vertebral artery disease on postoperative days 75 and 1821, respectively. The clinical course of these two patients has been previously published.[5] Six LSAC patients died during the follow-up period. Two of the deaths (a 62-year-old man and an 80-year-old woman) were in patients who had had a stroke (one preoperative and one postoperative). An 85-year-old woman died of complications of hemorrhagic shock after splenectomy. A 62-year-old man died
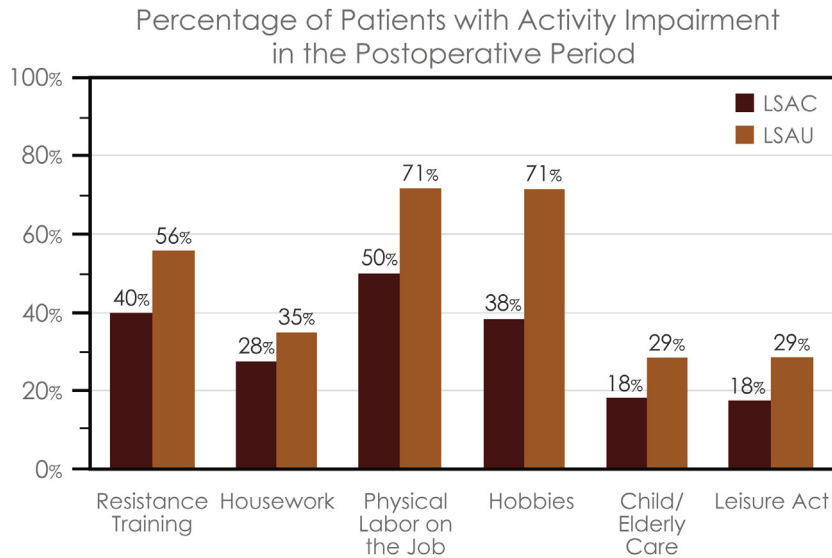
Percentage of Patients with Activity Impairment in the Postoperative Period

Fig 2. Percentage of patients with activity impairment in the postoperative period. *LSAC,* Left subclavian artery covered; *LSAU,* left subclavian artery uncovered.
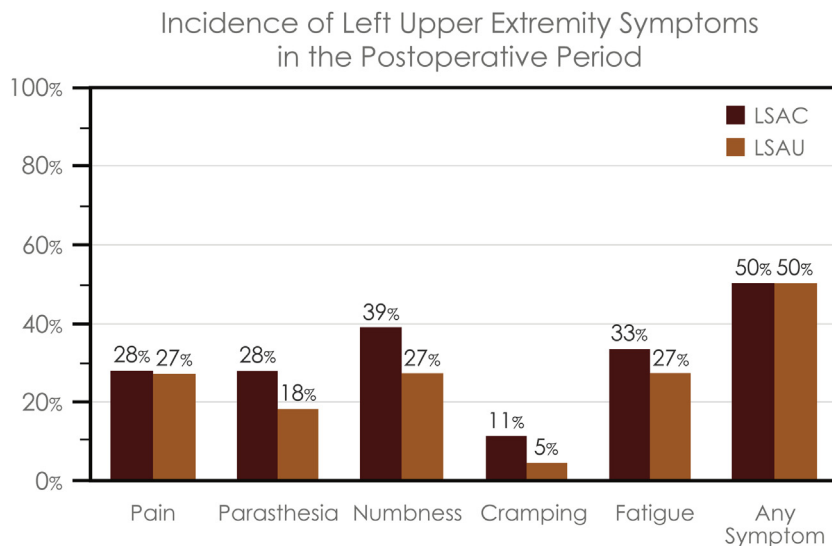
Incidence of Left Upper Extremity Symptoms in the Postoperative Period

Fig 3. Incidence of left upper extremity symptoms in the postoperative period. *LSAC,* Left subclavian artery covered; *LSAU,* left subclavian artery uncovered.

of complications of an aortobronchial fistula that developed 3 months after TEVAR. An 80-year-old woman died 61 days after TEVAR secondary to the severity of the associated injuries. Finally, an 87-year-old man died 1544 days after TEVAR of natural causes.

DISCUSSION

The societal burden of TAI is significant. Recent autopsy studies show up to one-third of deaths after motor vehicle accidents involve TAI.[8] According to the 2010 National Vital Statistics Report, an estimated 12,533 of the total 37,661 deaths may have involved TAI.[1] Motor

vehicle accidents, especially involving a head-on collision, cause >70% of all TAIs,[2,9] and 80% of these individuals die at the scene.[10] Of the patients who survive to be evaluated in a hospital, up to 50% die ≤24 hours of arrival.[11] Because TAI is a common and serious traumatic injury, an understanding of which treatment strategies reduce death and long-term complications to the greatest degree is of utmost importance.

In 2011, the SVS released practice guidelines for the use of TEVAR for TAI to help standardize care and make suggestions on case management based on the available evidence.[7] A meta-analysis assimilating data from 139

studies with 7768 patients led to the conclusion that TEVAR reduced mortality compared with open repair of TAI from 19% to 9% ($P < .01$).[4] The SVS subsequently developed guidelines for the optimal use of TEVAR, including the suggestion that selective revascularization based on the status of vertebrobasilar anatomy be used to minimize the potential increased risk associated with the routine performance of carotid-subclavian bypass. It is noteworthy that this recommendation was not made based on the meta-analysis but was founded on data consisting of case series, expert opinion, and observational studies. Additional research is warranted to more adequately define optimal selection criteria for bypass procedures after LSAC.

It is clear that a subset of patients is likely to benefit from subclavian revascularization. Several large studies have demonstrated an increased incidence of adverse neurologic events, such as stroke and SCI, in nonrevascularized patients compared with those routinely revascularized. A meta-analysis from 2009 comparing LSAC with LSAU patients found statistically significant increases in left arm and vertebrobasilar ischemia in the LSAC group, along with an increased risk of SCI and anterior circulation stroke that were not statistically significant.[12]

Buth et al,[13] analyzing data from the European Collaborators on Stent-Graft Techniques for Abdominal Aortic Aneurysm Repair (EUROSTAR) registry, found that routine revascularization reduced the risk of stroke and SCI compared with nonrevascularized patients ($P = .049$). This study constitutes one of the larger experiences with TEVAR but is based on a self-reported and nonconsecutive registry of patients.[13] A meta-analysis that included the EUROSTAR data as a heavily weighted contributor also found an increased risk of stroke (from 2.7% in revascularized to 4.7% in nonrevascularized) and risk of SCI (from 2.3% revascularized to 2.8% nonrevascularized), which was statistically significant ($P = .005$ for both findings). Revascularization was statistically protective for SCI, but not stroke.[14] Importantly, these analyses all included TEVAR patients treated for a variety of aortic pathology, with only a subset of these patients treated for TAI. This limits the applicability of the conclusions to outcomes of TAI patients, who may have a different long-term prognosis as a group.

A second procedure to revascularize the LSA is not without risk. Reported complications include injury to the thoracic duct, vagus nerve, phrenic nerve, subclavian vein, subclavian artery, and sympathetic nerves resulting in Horner syndrome.[15,16] Takach et al[17] reported a stroke risk of 2.1% during a 50-year experience with these revascularization procedures. Because of the documented risks associated with subclavian revascularization, several groups began to investigate the utility of selectively revascularization only in those patients whose symptoms after LSAC dictated the need for the second procedure.

Lee et al[18] published their single-institution experience supporting a strategy of selective revascularization. These investigators found no statistically significant difference between revascularized and nonrevascularized patients in

mortality (6.3% vs 1.8%; $P = .21$), paraplegia (3.1% vs 0%; $P = .22$), or stroke (3.1% vs 3.5%; $P > .99$). In addition, three of 32 (9.3%) revascularized patients developed complications from the procedure, emphasizing again that this procedure is not without inherent risks that must be considered.

A recent single-institution retrospective study found no difference in neurologic outcomes with and without revascularization after TEVAR.[19] These results were consistent with the findings of Woo et al,[20] who followed a protocol of selective revascularization and identified no statistically significant difference in stroke rate with and without revascularization (7% vs 11%, respectively; $P = .6$) when such a policy was used.

Lastly, Maldonado et al[21] produced the largest multicenter TEVAR experience in the literature by using data from six tertiary care centers. No significant difference was demonstrated between revascularized and nonrevascularized patients in SCI (4.1% vs 7.5%; $P = .2$) and stroke (6.4% vs 6.1%; $P = .9$).

As in these studies supporting routine revascularization, TAI was not a specific focus of these studies, limiting their applicability in aortic pathology of strictly traumatic etiology. Our stroke rate was similar to publications concerning TEVAR.[22]

The identification of risk factors for symptoms after LSAC will allow caregivers to better select good candidates for the procedure. The 2011 SVS practice guidelines identify angiography of the RVA as the measure that can probably be most expeditiously assessed in an emergency.[7] In one small study, Lee et al[23] could not identify an association between hypoplasia of the RVA or LVA dominance with SCI or stroke as long as both vertebral arteries were patent. The same study found a trend of progressive RVA hypertrophy in TEVAR patients during the postoperative follow-up period. Seven of 27 LSAC patients (25.9%) presented with this finding, with contrast-enhanced CT of their mean RVA diameter increasing from 3.5 ± 0.9 to 4.7 ± 0.9 mm during a 36-month interval. This may indicate that at least in a subset of patients, the RVA may respond with hypertrophy as a compensation mechanism for retrograde LVA flow after LSAC.

Antonello et al[24] performed a similar analysis of vertebral anatomy and found that side of dominance was not an important predictor of postoperative symptoms. However, no hypoplastic vertebral arteries (as defined by a diameter of <2 mm) were identified in the study patients.[24] Our analysis of vertebral artery anatomy and symptomatology, however, revealed that increasing RVA dominance was negatively correlated with presence of numbness ($r = -0.66$; $P = .02$). Further investigation of vertebrobasilar anatomy and its relationship to symptoms may prove useful in the selection of good candidates for LSAC and determining the probability that revascularization will be required.

Left arm ischemia has been presented as a concern for LSAC without revascularization by a number of researchers.[19,24,25] Although these investigators have reported the incidence of left arm ischemia in their

respective cohorts, there has been no previous attempt to estimate the effect of those symptoms on patient-reported quality of life. Our use of the SF-12v2 represents the first analysis using tools designed to directly measure quality of life in long-term follow-up for LSAC patients. Because we found no long-term difference in quality of life and ability to maintain normal activities, the benefit that patients with normal vertebrobasilar anatomy experience from revascularization may prove to be minimal compared with the risk for complications.

Previous studies have focused on incidence of symptoms in LSAC patients without regard to severity. However, mild symptoms that cause no impairment may not warrant further surgical intervention. In addition, future commercial thoracic aortic stent grafts will incorporate branched technology, allowing for subclavian revascularization during the index procedure.

Limitations to this investigation include its single-center participation, which may limit the general applicability to all TAI patients. This study also involves a relatively small cohort. However, the literature is lacking studies with large patient populations specifically focused on TEVAR with LSAC for TAI. Although power may be a concern owing to the small cohort, we investigated the expected relationship among quality of life scores, symptoms, and activity impairment and found a statistical association. This implies any residual effects of LSAC on quality of life would be less significant than these relationships (Supplementary Table, online only). In addition, there was loss to follow-up as described in the Results. This loss to follow-up is significant, but is comparable to our past experience with follow-up compliance in trauma patients.[26,27]

CONCLUSIONS

Intentional coverage of the LSA during TEVAR for TAI appears safe, without compromising mental or physical health outcomes. Furthermore, LSAC does not appear to increase the long-term risk of upper extremity symptoms or impairment of normal activities. Because TEVAR is now the treatment of choice for amenable patients with TAI, a more complete understanding of the consequences of intentional LSAC will prove beneficial in assessment of potential risk and benefit for individual cases. Although follow-up in trauma patient groups remains a challenge, more research is needed to better understand long-term outcomes of LSAC.

AUTHOR CONTRIBUTIONS

Conception and design: AA, CM, CCM, AP, KC, AE, HS
Analysis and interpretation: AA, CM, CCM
Data collection: CM, CCM, AP
Writing the article: AA, CM, JD
Critical revision of the article: AA, JD, CCM, KC, AE, HS
Final approval of the article: AA, JD, CCM, KC, AE, HS
Statistical analysis: CCM, AP
Obtained funding: Not applicable
Overall responsibility: AA

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DISCUSSION

Dr W. Anthony Lee (*Boca Raton, Fla*). Good morning. I would like to thank the Program Committee for the privilege of discussing this paper and the authors for sending me a copy of the manuscript way in advance of the meeting.

The manuscript is well written and the topic should be of interest to this audience. The advent of thoracic endovascular aortic repair (TEVAR) has forced vascular surgeons to recognize that the left subclavian artery is not some vestigial vessel that can be indiscriminately covered without consequences. Despite the relatively large body of literature addressing the need for left subclavian revascularization during TEVAR, including a recently published Society for Vascular Surgery (SVS) Clinical Practice Guidelines, opinions remain sharply divided.

Extrapolation of what we knew about left subclavian physiology from occlusive disease clearly did not apply in patients with an acutely occluded left subclavian artery during TEVAR. Acute occlusion has been associated with arm ischemia, posterior circulation stroke, and spinal cord ischemia. The reasons behind the inconsistent presentations stem from a combination of the variable collateral circulation of the left subclavian artery, some of which share their blood supply with the central nervous system, the right-handed dominance of most of the human population, and the asymmetry of vertebral anatomy.

In the paper just presented, the authors share their large experience in repair of traumatic aortic injuries spanning 7 years and report on the subset of those who underwent TEVAR, specifically addressing the issue of the impact on the quality of life after left subclavian artery coverage. This is a difficult subset of patients in whom to conduct a quality of life study especially in the context of associated injuries that may impact left arm function that is not discoverable through a single metric such as the Injury Severity Score. It is with this confounding background the results should be interpreted. I have a few questions for the authors:

1. Who conducted the interviews? Did a single person conduct them or multiple?
2. How many of the covered and uncovered subjects in the study were left-handed? No data are presented regarding this important functional parameter, which can affect how the results are interpreted.
3. "Mental health score"–why would coverage of left subclavian artery result in an improvement in this outcome measure? Or is this simply a result of statistical mining?
4. Please expound on the relevance of right vertebral anatomy, in terms of size and dominance, as it relates left arm function.
5. In the one patient who had a perioperative posterior circulation stroke, was his or her subclavian covered or uncovered? And if covered, was it revascularized eventually? The word "perioperative" is unclear. When did it occur exactly? Preop or postop?

Once again thank you for the privilege of discussing this paper.

Cameron McBride. Dr Lee, thank you for those questions. They address some important points. Let me start with the question about the authors. Two authors worked together to create the protocol for the questionnaire, and those same two authors were the ones who carried out the interviews.

In regard to the left- and right-handedness of the patients, it was asked about during the survey process; however, it was not part of our analysis, and I do not have that information available today. In future studies, it will be a point of interest because we understand its importance.

With the mental health scores, we do not give any particular importance to the fact that the mental health scores were better in the covered group, and we would like to see that replicated in future studies before we say that is a clinically meaningful finding.

With the patient who had the stroke, the reason the word perioperatively was used was because it was somewhat unclear when the stroke happened. The patient was under general anesthesia, and the symptoms were noticed when she woke up, so it is difficult to determine exactly when the patient had the stroke. It is possible that the stroke was intraoperative.

In response to the right vertebral artery (RVA) anatomy: Because after the left subclavian artery is covered the right vertebral becomes the main supply to the posterior circulation of the brain, and via retrograde flow through the left vertebral also to the left arm, we suspected that people with larger RVAs would be better able to compensate after the coverage. The same was thought about RVA dominance, because those that are right vertebral dominant before the coverage occurs do not have as large of a disturbance to the vertebrobasilar junction after coverage, so we suspected that that group would be able to compensate better as well. However, because those with large RVAs are more likely to be right vertebral dominant, it could be that that is just a reiteration of the size finding.

Supplementary Table (online only). Correlations of SF-12v2[a] scores with symptoms and impairment

SF-12v2	Measure of impairment	Correlation coefficient	P
Physical health	Presence of paresthesia	−0.28	.03
	Duration of paresthesia	−0.35	.03
	Presence of numbness	−0.31	.05
	Duration of numbness	−0.39	.01
	Presence of fatigue	−0.36	.02
	Duration of fatigue	−0.36	.02
	Impairment of leisure activities	−0.62	<.0001
	Impairment of physical labor	−0.68	.0001
	Impairment of cardiovascular exercise	−0.38	.03
	Impairment of resistance training	−0.76	.0001
	Impairment of child/elderly care	−0.55	.02
	Impairment of hobbies	−0.82	<.0001
	Impairment of sports	−0.78	.002
	Impairment of housework	−0.68	<.0001
Mental health	Presence of paresthesia	−0.30	<.01
	Duration of paresthesia	−0.39	.01
	Presence of numbness	−0.47	<.01
	Duration of numbness	−0.47	<.01
	Presence of fatigue	−0.32	.04
	Duration of fatigue	−0.31	.05
	Impairment of physical labor	−0.53	.005
	Impairment of cardiovascular exercise	−0.67	<.0001
	Impairment of resistance training	−0.61	.006
	Impairment of child/elderly care	−0.52	.03
	Impairment of hobbies	−0.54	.01
	Impairment of sports	−0.63	.02
	Impairment of housework	−0.52	.0008

[a]Quality Metrics, Lincoln, RI.