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TCAR can safely be performed with regional anesthesia and no ICU stay

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Keywords: TCAR, carotid stenosis, anesthesia type, carotid stenting

ARTICLE HIGHLIGHTS

Type of Research: single center, retrospective cohort study

Key Findings: Patients treated with transcarotid artery revascularization (TCAR) using regional anesthesia had low rates of ICU admission postoperatively (7%), and compared with patients undergoing TCAR with general anesthesia had a shorter overall length of hospital stay (1.4 vs 4.2 days) and lower rates of postoperative myocardial infarction, stroke, and death (0% vs. 2.4%).

Take home Message: TCAR can safely be performed while avoiding both general anesthesia and an ICU stay in most patients.

Table of Contents Summary

Patients undergoing TCAR with regional anesthesia compared to general anesthesia had shorter overall length of hospital stays and lower rates of postoperative complications. TCAR can safely be performed while avoiding both general anesthesia and an ICU stay in most patients.

Abstract

Objectives: Hospital resource utilization is under constant review and the extent and intensity of postoperative care requirements for vascular surgical procedures is particularly relevant in the setting of the COVID19 pandemic and its impact on staffed ICU beds. We sought to evaluate the feasibility of regional anesthesia and low-intensity postoperative care for patients undergoing transcarotid artery revascularization (TCAR) at our institution.

Methods: All patients undergoing TCAR at a single institution from 2018-2020 were reviewed. Perioperative management (anticoagulation/antiplatelet therapy, hemodynamic monitoring, neurovascular exam, nursing instructions) was standardized by use of an institutional protocol. Anesthetic modality was at the surgeon's preference. Patients were transferred to PACU for 2 hours followed by the step-down unit, to PACU for 4 hours followed by the floor, or alternatively transferred to ICU. IV blood pressure medications could be administered at all environments except the floor. Recovery location and length of stay (LOS) were recorded.

Results: A total of 83 patients underwent TCAR during the study period. Mean age 72 +/- 9, 59% male. Thirty-six percent were symptomatic. Regional anesthesia was utilized for 84% with none converted to general anesthesia intraoperatively. Post operatively only 7 (8%) patients out of all 83 patients included in this study were monitored in an ICU overnight (decided perioperatively), mostly for patients with prior neurological symptoms but in one case for postoperative neurological event and in another due to pulseless electrical activity arrest. Six patients required IV antihypertensives and eight required IV vasoactive support postoperatively. Mean length of ICU stay was 3.7 +/- 5.1 days. Mean length of hospital stay for all patients was 2.4 +/- 3.3 days. The length of stay for patients undergoing TCAR with general anesthesia was higher than those undergoing TCAR with regional anesthesia (4.2 +/- 4.9 days versus 1.4 +/- 1.2 days, respectively; p=0.066). Incidence of stroke, death, and MI was 2.4%. There was 1 postoperative stroke considered to be a recrudescence of prior stroke, and one respiratory arrest fatality in a frail patient with neck hematoma both of whom were treated under GA.

Conclusion: Using perioperative care protocols, TCAR can safely be performed while avoiding both general anesthesia and an ICU stay in most patients.

Introduction

Transcarotid artery revascularization (TCAR) has emerged as a technique for treating carotid artery stenosis, a significant cause of ischemic stroke, and has significant advantages in patients with high lesions, prior neck surgery or radiation, and employs a flow reversal mechanism to lower the risk of embolic stroke. Several studies have compared patient outcomes in TCAR vs CEA and found overall equivalent outcomes in procedure-related strokes, MI, and death[1,2]. In addition, data analyzed from the Society for Vascular Surgery Vascular Quality Initiative TCAR Surveillance Project actually showed lower rates of postoperative MI and cranial nerve injury in patients undergoing TCAR compared to patients undergoing CEA[3].

TCAR has also been associated with shorter procedure times and overall hospital stays, which offers another advantage compared to CEA[4]. Additionally, use of regional anesthesia (RA) over general anesthesia (GA) in carotid surgery further shortens hospital stays and improves patient perception of recovery in appropriately chosen patients[5-7]. Although there are few studies specifically analyzing anesthesia type in TCAR, use of RA might be an important way to improve resource utilization for carotid surgeries.

Given the benefits in patient outcomes and resource utilization with TCAR, the advantages of TCAR become particularly relevant in the setting of the COVID19 pandemic. Hospital resource utilization is under constant review, especially given the extent of postoperative care needed for most vascular procedures. In this study, we sought to evaluate the feasibility of TCAR using RA and low-intensity postoperative care at our institution.

Methods

All patients at high risk for carotid endarterectomy undergoing TCAR at a single institution from 2018-2020 were reviewed. Consent for publication and IRB approval was

obtained for all patients reviewed. Perioperative management was standardized by use of an institutional protocol including hemodynamic parameters (goal heart rate 60-100 bpm, goal mean arterial pressure >65mmHgwith systolic blood pressure <160mmHg) and requisite medications (medication reconciliation performed on all patients), anticoagulation/antiplatelet regimens, neurovascular exam guidelines (neurovascular exam both preoperatively and postoperatively) and nursing instructions. Anesthetic modality was at the surgeon's preference.

Patients were transferred to PACU for 2 hours (1:1/1:2 nursing ratio) followed by the step-down unit (1:4 nursing ratio), to PACU for 4 hours followed by the floor (1:6 ratio) or alternatively transferred to ICU (1:1 ratio). IV blood pressure medications could be administered at all environments except the floor. Step down unit was the preferred location with regular floor utilized when step-down beds were unavailable and ICU beds utilized only when higher levels of vasoactive medication or ventilatory support were required. Recovery location and length of stay (LOS) were recorded.

Anesthetic choice was at surgeon discretion with one provider favoring general anesthesia for all carotid procedures and two providers preferring regional block and selectively utilizing general anesthesia for impaired neck mobility, patient inability to lay flat and still (i.e. back pain, recent stroke, psychological impairment), or patient anxiety/request. Regional anesthesia consisted of a superficial cervical block performed by a dedicated regional anesthesia team. Use of ultrasound guidance versus anatomic landmarks and lidocaine versus ropivacaine was at the anesthetists discretion.

Results

A total of 83 patients underwent TCAR during the study period. The mean age was 72 +/- 9 years, and 59% were male. 36% of patients were symptomatic.

Anesthesia Type

Regional anesthesia (RA) with ropivacaine or lidocaine was utilized for 84% of patients with none converted to general anesthesia (GA) intraoperatively. 13 patients were selected to undergo TCAR with GA in the preoperative evaluation. There were no significant differences between the medical comorbidities of patients chosen to undergo GA or RA.

Intraoperative Interventions

Overall, mean procedure time (time spent from incision to closure) was 75 minutes with mean flow reversal time of 8 minutes. When accounting for anesthesia type, mean procedure time was significantly longer in patients undergoing TCAR with GA (Table 1). However, there was no significant difference in flow reversal time between RA and GA.

The most common intervention intraoperatively was for hypotension, with 78% of patients requiring vasopressors, most commonly intravenous phenylephrine. Patients under GA required significantly more phenylephrine than those under RA (4997.0 +/- 3602.3 mcg vs 1736.5 +/- 1826.9 mcg, respectively; p=0.01). In addition, 39% of all patients required antihypertensives, and 10% required treatment for bradycardia.

Postoperative Care

Postoperatively, only 7 (8%) patients were monitored in an ICU overnight (decided perioperatively). In most cases, this was decided for symptomatic patients with prior neurological symptoms. However, one patient was admitted to the ICU for a postoperative neurological event and another patient due to pulseless electrical activity arrest. The remaining seventy-six (92%) patients were monitored in PACU, of which 8 were transferred to the floor

after 4 hours, and 13 were discharged directly from PACU due to limited bed availability (Figure 1). Fifty-five of those in PACU were transferred to the step-down unit after 2 hours and discharged from there.

Figure 1: Postoperative Location

Majority of patients were maintained at an appropriate blood pressure with oral antihypertensives. However, 14 patients required IV medications for hypertension or hypotension postoperatively. Of the 14, only two patients had undergone TCAR under GA. Six patients required IV treatment for hypertension with cardene, and eight patients required IV vasoactive support with phenylephrine. When compared to patients not requiring IV medications, patients treated with IV cardene or phenylephrine had longer hospital stays, although this did not reach significance (2.1 +/- 2.9 days vs 4.1 +/- 4.7 days, respectively; p=0.162). Out of 13 total patients that underwent TCAR with general anesthesia, only three patients required ICU admission. There was no post operative location difference by surgeon, only by anesthetic.

Length of Hospital Stay

Mean length of hospital stay for all patients was 2.4 +/- 3.3 days with median length of hospital stay of 1 day. Mean length of ICU stay was 3.7 +/- 5.1 days (range 1-15 days). Patients requiring ICU stay had longer overall length of postoperative hospital stay compared to patients that did not require ICU care (Figure 2: 5.4 +/- 5.7 days vs 1.5 +/- 1.5 days, respectively; p=0.119). When accounting for differences in anesthesia type, the mean postoperative length of stay for patients undergoing TCAR with GA was also higher than those undergoing TCAR with RA (Figure 2: 4.2 +/- 4.9 days versus 1.4 +/- 1.2 days, respectively; p=0.066). Median length of stay for patients undergoing RA and GA were both 1 day.

Figure 2: Length of Hospital Stay by Anesthesia Type and ICU Stay

Postoperative Complications

Incidence of stroke, death, and MI was 2.4% (2 patients). Both of these patients were treated under GA. There was 1 postoperative stroke considered to be a recrudescence of prior stroke, and one respiratory arrest fatality in a frail patient with neck hematoma.

Discussion

In this study, we have shown that patients can be safely and effectively treated with TCAR while minimizing ICU stays and improving resource utilization through shorter procedure times. In our patient sample, opting to perform TCAR under RA over GA was associated with a shorter length of hospital stay and total procedure time, while minimizing postoperative complications. None of the patients undergoing TCAR under RA experienced stroke, MI, or death in the immediate postoperative period, while 2 out of 14 patients undergoing TCAR with GA experienced postoperative complications. Importantly, there was no significant difference in presence of medical comorbidities between the two groups, although our analysis does not account for differences in severity of disease.

The optimal mode of anesthetic delivery in carotid surgery has been debated for years and to this date, there has been no clear consensus between the use of GA versus RA. While both options have advantages and disadvantages, our institution prefers the use of RA, in order to promptly diagnose any neurological changes in the patient intraoperatively. The most well-known of studies comparing RA vs GA, the GA versus RA for carotid surgery (GALA) trial, showed no statistically significant differences in patient outcome between RA and GA[8]. Several smaller studies have also shown that RA in CEA allows for a shorter surgical time and ICU/hospital stay with equal or better patient outcomes in stroke rate, MI, and death when

compared to GA[5, 9, 10]. Although few studies have been done comparing GA to RA after TCAR, the existing studies conclude that patients receiving RA had significantly shorter hospital stays and a lower 30 day mortality, consistent with what we report here[11]. As we have demonstrated here, a majority of patients can be safely treated with regional anesthesia, and thus we recommend regional block anesthesic as principal choice unless patients exhibit impaired neck mobility, patient inability to lay flat and still (i.e. back pain, recent stroke, psychological impairment), or severe anxiety.

Treatment with IV medications for hypertension or hypotension postoperatively was also associated with longer hospital stays. These findings are also supported by another single center, retrospective review showing that hemodynamic instability in the immediate postoperative period after TCAR is associated with longer time in the ICU, as well as overall length of hospital stay[12]. In a larger VQI study, postoperative hypotension requiring vasoactive support for longer than 15 minutes was associated with longer hospital stays and higher rates of neurologic and cardiac events[13]. Several risk factors for development of postoperative hemodynamic instability have been identified including symptomatic carotid artery stenosis, preoperative hypertension, and calcified plaques[14].

Several limitations to our research exist including a smaller sample size of patients undergoing TCAR with GA compared to RA, which may contribute to some of the nonsignificant findings. In addition, one of the patients undergoing TCAR with GA required ICU admission for 15 days, which likely contributed to the prolonged mean length of stay in GA patients versus RA patients. Our analysis with the median length of stay is therefore more appropriate in this case, with median length of stay showing no significant difference between GA and RA patients.

Conclusion

Using perioperative care protocols, TCAR can safely be performed while avoiding both general anesthesia and an ICU stay in most patients. Opting for regional anesthesia over general anesthesia may lower length of hospital stay and procedure times, while maintaining equal or better patient outcomes.

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Table 1: Intraoperative Times with Regional versus General Anesthesia

	Regional Anesthesia	**General Anesthesia**	**P value**
Mean Procedure Time	72.0 +/- 18.1 minutes	94.8 +/- 37.1 minutes	0.049
Mean Flow Reversal Time	7.9 +/- 3.4 minutes	9.8 +/- 8.9 minutes	0.454

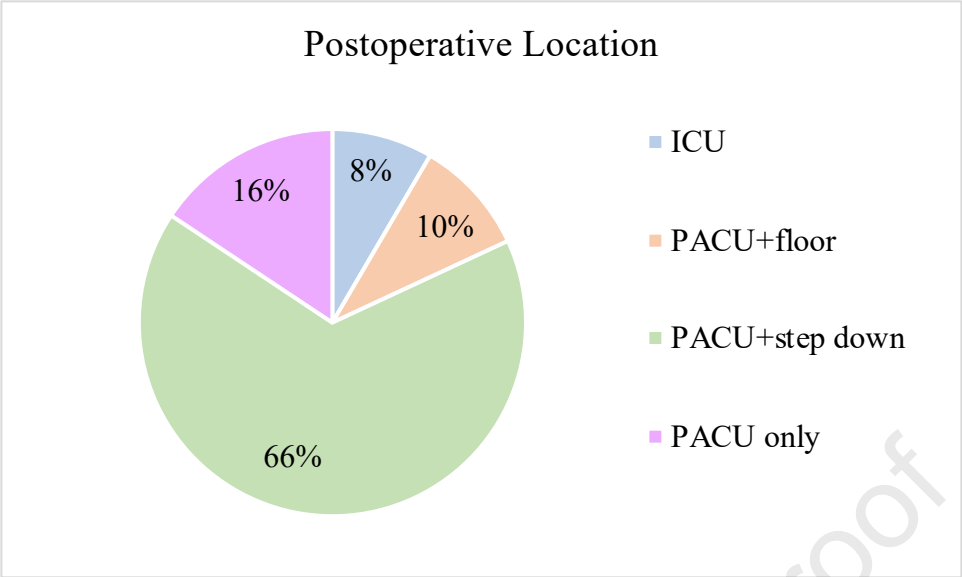

Figure 1: Postoperative Location

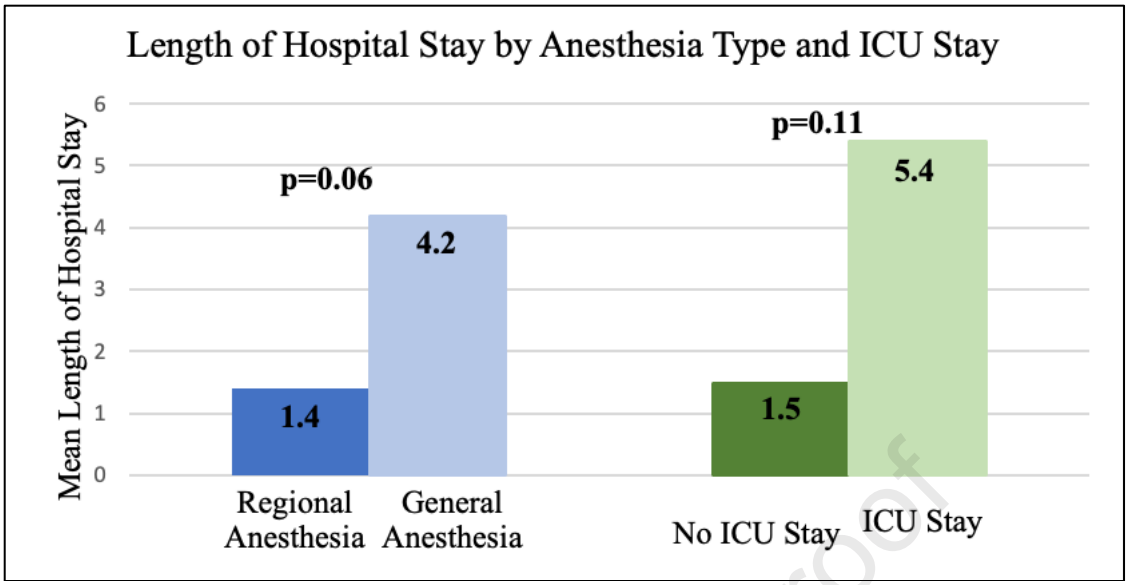

Figure 2: Length of Hospital Stay by Anesthesia Type and ICU Stay

Legends

Table 1: Intraoperative Times with Regional versus General Anesthesia

Figure 1: Postoperative Location

Figure 2: Length of Hospital Stay by Anesthesia Type and ICU Stay