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Original Research

Endoscopic Carpal Tunnel Release With Monitored Anesthesia Care Versus Local Anesthesia: Analysis of Operative Times and Patient-Reported Outcomes

Akhil Dondapati, MD, * Thomas Carroll, MD, * Constantinos Ketonis, MD, PhD *

* University of Rochester Department of Orthopaedic Surgery, University of Rochester Medical Center, Rochester, NY

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Purpose: Carpal tunnel syndrome is the most common peripheral nerve compressive neuropathy in clinical practice. Patients who fail nonsurgical management are indicated for carpal tunnel release (CTR), which can be performed open or endoscopically. Efforts have been made to utilize local anesthesia instead of monitored anesthesia care (MAC) for endoscopic release. This study seeks to compare perioperative surgical times and postoperative outcomes in patients undergoing endoscopic CTR with local anesthesia versus MAC.

Methods: This is a 6-year retrospective study of 1,036 patients undergoing isolated endoscopic CTR with MAC (n = 607) versus local (n = 429) anesthesia within an outpatient surgical center. A combination of chi-square and *t* tests was used to compare the patient characteristics, operative details, and outcomes.

Results: The local cohort demonstrated significantly shorter postoperative time to discharge (15.9 ± 9.8 vs 53.8 ± 11.0 minutes; $P < .05$), total time spent in surgical center (83.2 ± 18.7 vs 129.3 ± 20.7 minutes; $P < .05$), shorter total operating room time (26.7 ± 4.3 vs 29.0 ± 4.1 minutes; $P < .05$) and tourniquet time (12.4 ± 2.5 vs 13.1 ± 2.1 minutes; $P < .05$). Preoperative and postoperative Patient-Reported Outcomes Measurement Information System (PROMIS) scores were similar between the cohorts ($P > .05$); however, PROMIS pain interference improved to a higher degree between pre- and post-op in the local group (−1.5 vs −0.8; $P = .02$). Early and late surgical complications were similar between the groups ($P > .05$).

Conclusions: Patients within the MAC cohort demonstrated longer postoperative time to discharge and total time in the surgical center. The MAC cohort had longer operating room and tourniquet time, albeit not clinically significant. Surgical complications and PROMIS scores were similar between the two groups. Our findings suggest that local anesthesia is a safe and effective option for endoscopic CTR and may offer advantages in cost and convenience for patients.

Type of study/level of evidence: Retrospective cohort study/therapeutic III.

Carpal tunnel syndrome is the most common peripheral nerve compressive neuropathy seen in clinical practice.[1] Prevalence of this condition varies widely by study and diagnostic criteria, but estimates place it upward of 10% during a patient's lifetime.[2] Patients who fail nonsurgical management are indicated for surgical carpal tunnel release (CTR). This procedure is one of the most commonly performed orthopedic surgeries, with approximately 577,000 performed in the United States in 2006 and increasing each year and can be performed through either an open or endoscopic approach, based on surgeon and patient preference.[3]

Given the large number of cases each year, there have been many efforts to decrease costs and complication rates while increasing efficiency, patient convenience, and outcomes. Some measures include utilizing outpatient surgical centers, less invasive techniques, eliminating postoperative splinting, removing the need for day-of-surgery fasting, and reducing turnover time in the operating room.[4] One of the largest efforts implemented, however, is the use of local anesthesia. This technique is often more convenient for patients, has been shown to increase cost effectiveness compared with monitored anesthesia care (MAC), and has eliminated the need for perioperative and postoperative anesthesia

Corresponding author: Akhil Dondapati, MD, University of Rochester Department of Orthopaedic Surgery, University of Rochester Medical Center, 601 Elmwood Avenue, Rochester, NY 14642.
E-mail address: akhil_dondapati@urmc.rochester.edu (A. Dondapati).

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monitoring in patients undergoing CTR.[5] Additionally, minimal differences exist in opioid pain medication use and pain scores when comparing local anesthesia versus MAC techniques.[6]

There have been a number of studies investigating the differences between local anesthesia and MAC in patients undergoing open CTR (OCTR), but the same comparisons have not been thoroughly investigated in the setting of endoscopic CTR (ECTR). Endoscopic CTR, which was first described in 1987, has recently been gaining popularity among surgeons. It has been shown to have comparable outcomes with OCTR while having the theoretical benefits of earlier return to work and reduced postoperative pain.[7,8] With a growing trend toward ECTR, a comparison of local anesthesia and MAC in this setting remains of clinical significance.

This study seeks to compare perioperative surgical times and postoperative outcomes and costs in patients undergoing ECTR with local anesthesia versus MAC. We hypothesized that operative times, time to discharge, tourniquet times, and patient satisfaction will be improved with local anesthesia without significant differences in postoperative Patient-Reported Outcomes Measurement Information System (PROMIS) scores or complication rates.

Table 1
Cohort Characteristics of Patients Undergoing ECTR With MAC Versus Local Anesthesia

Characteristic	MAC (n = 607)	Local Anesthesia (n = 429)	*P* Value
Age (y), mean (SD)	51 (12)	54 (13)	**<.05**
BMI (kg/m^2), mean (SD)	29 (6)	32 (6)	**<.05**
Sex, n (%)			.299
Female	348 (57)	232 (54)	
Male	259 (43)	197 (46)	
Race, n (%)			.452
White	516 (85)	381 (89)	
Black	68 (11)	43 (10)	
Other	23 (4)	5 (1)	
Ethnicity, n (%)			.125
Not Hispanic	552 (91)	403 (94)	
Hispanic	28 (5)	12 (3)	
Unknown	27 (4)	14 (3)	
Dominant hand, n (%)	382 (62.9)	277 (64.6)	.589
Tobacco use, n (%)	85 (14.0)	69 (16.1)	.354
Diabetes, n (%)	97 (16.0)	78 (18.2)	.352
Hypothyroidism, n (%)	30 (4.9)	34 (7.9)	.052

Statistically significant *P*-values are bolded.

Materials and Methods

This study was approved by our institutional review board. As this was a retrospective analysis of a patient database, a waiver of consent was obtained. The study was performed at a single, urban level 1 trauma and academic medical center in the Northeast United States. Patients were identified using the Current Procedural Terminology code 29848. Patients in this study were all between the ages of 18 and 75 years and underwent ECTR between October 1, 2015, and October 1, 2021. Monitored anesthesia care cases were performed by a combination of three fellowship-trained hand surgeons (C.K.), whereas local cases were performed by two fellowship-trained hand surgeons. Inclusion criteria were patients who had at least one preoperative (within 6 months of surgery) and postoperative (within 4 weeks or surgery) PROMIS score. Exclusion criteria were patients aged less than 18 years or greater than 75 years and those with traumatic carpal tunnel syndrome, concomitant procedures, prior ipsilateral CTR, or prior wrist surgery. All charts and operative notes were reviewed to confirm that patients were diagnosed with carpal tunnel syndrome and underwent endoscopic release. Additionally, patients who underwent contralateral CTR were identified through chart review, and only the index procedure was included in this study. All data were deidentified and kept safely within the hospital network. All patients underwent ECTR with tourniquet, under either MAC or local anesthesia. The decision for anesthesia type was based on a combination of patient and surgeon preference and surgical procedure room availability throughout the study period. Specific medical comorbidities were not universally utilized in the determination of anesthesia type, as it was determined to likely not be of significant consequence. Local anesthesia comprised of 10 cc of 1:1 solution of 1% lidocaine with epinephrine and 2% Marcaine injected superficial to the transverse carpal ligament within 30 minutes of the procedure. Monitored anesthesia care anesthesia was delivered with a weight-based combination of midazolam, fentanyl, and propofol, per the discretion the anesthesia team. Medical staff in the local anesthesia group typically consisted of the attending physician, one resident, one scrub technician, and one circulating nurse. The MAC group in addition included an anesthesiologist and/or a certified nurse anesthetist, as well as preanesthesia and postanesthesia nurses. Intravenous access was also required in the MAC group that was not placed in the local group.

Demographic data, including the age, sex, body mass index (BMI), race (self-reported), and ethnicity (self-reported), as well as hand dominance, tobacco use, and history of diabetes or hypothyroidism, were identified by chart review. With regards to perioperative and postoperative outcomes, total operating room time, tourniquet time, time to discharge, total time in surgical center, complications, number of postoperative visits were recorded via chart review and anesthesiology operative reports. Complications were categorized as superficial infection (with or without return to operating room), deep infection, revision for symptom persistence, and revision for new onset of symptoms after a period of relief. All complications were included within 1 year of index procedure. PROMIS upper extremity, physical function, and pain interference were collected at routine clinic follow-up appointments both before and after surgery. The postoperative PROMIS scores were collected at the first postoperative visit between 1 and 3 weeks (mean, 15.4 days; SD, 2.3 days). Change in PROMIS scores was calculated as the mean of each individual patient's difference between postoperative and preoperative scores.

Statistical analysis was performed with Microsoft Excel and RStudio (R Foundation for Statistical Computing, Version 2022.07.0). Descriptive statistics including mean, SD, and frequency were calculated for all demographic variables. Response variables' statistical calculations were conducted using unpaired *t* test and chi-square analysis. Values of $P < .05$ were considered statistically significant.

Results

A total of 1,036 patients underwent primary ECTR in our cohort with 607 (58.6%) undergoing the procedure under MAC and 429 (41.4%) under local anesthesia at the same surgical center. The mean age in the MAC group was significantly younger than the local group (51 vs 54; $P < .05$), and the BMI was significantly lower (29 vs 32; $P < .05$). Sex, race, ethnicity, hand dominance, and history of diabetes were not significantly different between the groups (Table 1).

Analysis revealed that total operating room time (26.7 vs 29.0 minutes; $P < .05$), tourniquet time (12.4 vs 13.1 minutes; $P < .05$), postoperative time to discharge (15.9 vs 53.8 minutes; $P < .05$), and total time in surgical center (83.2 vs 129.3 minutes; $P < .05$) were all significantly lower in the local group compared with the MAC group.

Table 2
Operative Details of Patients Following ECTR With MAC Versus Local Anesthesia*

Characteristic	MAC (n = 607)	Local Anesthesia (n = 429)	*P* Value
Total operating room time, mean (SD)	29.0 (4.1)	26.7 (4.3)	**<.05**
Tourniquet time, mean (SD)	13.1 (2.1)	12.4 (2.5)	**<.05**
Postoperative time to discharge, mean (SD)	53.8 (11.0)	15.9 (9.8)	**<.05**
Total time in surgical center, mean (SD)	129.3 (20.7)	83.2 (18.7)	**<.05**
Complications, n (%)			
Superficial infection†	7 (1.2)	4 (0.9)	.73
Superficial infection with return to operating room‡	4 (0.7)	2 (0.5)	.68
Deep infection with RTOR	0 (0)	0 (0)	1.0
Revision for symptoms persistence	9 (1.5)	3 (0.7)	.25
Revision for new onset symptoms§	7 (1.2)	3 (0.7)	.46
Number of postoperative visits, mean (SD)	1.5 (0.8)	1.4 (0.9)	.06

Statistically significant *P*-values are bolded.
* Operative times provided in minutes.
† Superficial infection requiring only oral antibiotics.
‡ Superficial infection requiring return to operating room.
§ Patients with initial period of symptom relief then new onset of carpal tunnel symptoms requiring return to operating room.

Table 3
PROMIS Scores of Patients Following ECTR With MAC Versus Local Anesthesia

Characteristic	MAC (n = 607)	Local Anesthesia (n = 429)	*P* Value
Preoperative PROMIS upper extremity, mean (SD)	38.7 (7.8)	38.5 (8.4)	.69
Postoperative PROMIS upper extremity, mean (SD)	37.9 (6.2)	37.4 (6.9)	.22
Change in PROMIS upper extremity,* mean (SD)	−0.8 (3.2)	−1.1 (4.2)	.19
Preoperative PROMIS physical function, mean (SD)	42.9 (8.1)	43.2 (7.4)	.54
Postoperative PROMIS physical function, mean (SD)	43.5 (5.9)	42.9 (7.1)	.14
Change in PROMIS physical function,* mean (SD)	0.6 (2.9)	−0.3 (2.4)	.08
Preoperative PROMIS pain interference, mean (SD)	57.0 (7.1)	57.3 (8.2)	.53
Postoperative PROMIS pain interference, mean (SD)	56.2 (5.9)	55.8 (6.8)	.31
Change in PROMIS pain interference,* mean (SD)	−0.8 (5.7)	−1.5 (5.8)	.06

* Change in PROMIS scores calculated from the difference in averages between preoperative and postoperative scores.

Complication rates in each group were notably low and not significantly different between treatment groups. Specifically, there was no significant difference with regards to superficial infections, superficial or deep infections requiring return to the operating room, revision surgery for persistent symptoms, and revision surgery for onset of new symptoms. The number of postoperative office visits was very similar between the MAC and local groups (1.5 vs 1.4; $P = .06$) (Table 2).

Furthermore, preoperative and postoperative, as well as the total change in PROMIS upper extremity, physical function, and pain interference, scores were not significantly different between the two groups (Table 3).

Discussion

This study demonstrated that ECTR using local anesthesia is associated with lower total operating room time, postoperative time to discharge, and total time in surgical center compared with utilization of MAC. Tourniquet time, although found to be statistically less in the local group, might not be clinically relevant. Additionally, complication rates and postoperative outcomes and number of visits were comparable between the two groups. These data provide insight into potentially increasing patient convenience, decreasing use of surgical center resources, decreasing cost, and increasing the efficiency of ECTR.

In our cohort, the total operating room time, postoperative time to discharge, and total time in surgical center were significantly shorter in patients who received local anesthesia compared with those who received MAC. This is likely due to the reduced need for preoperative preparation, intraoperative and postoperative monitoring, and obviating the need for intravenous access placement and preoperative anesthesia evaluation. Although the tourniquet time and total operating room time were statistically shorter, this may not reflect a clinically significant difference. There are multiple studies that demonstrate the effectiveness of local anesthesia in patients undergoing OCTR, but literature regarding its use for ECTR is limited. A meta-analysis by Abukhudair et al[9] revealed that patients undergoing ECTR with local anesthesia had shorter operative times and higher patient satisfaction rates compared with the regional and general anesthesia, which is in agreement with our findings. However, they were unable to determine significance due to the small number of articles included. Although our study did not investigate patients undergoing the wide-awake local anesthesia no tourniquet local technique (WALANT), Wellington et al[10] compared those patients with ones who underwent MAC and local anesthesia with a tourniquet. They found that patients undergoing ECTR with wide-awake local anesthesia no tourniquet had shorter procedure times, postanesthesia care unit time, and door-to-door time than those with MAC. Shorter time in the operating room and surgical center per patient can, theoretically, yield a larger volume of cases per day and increased cost effectiveness.

It has previously been demonstrated that ECTR is generally more expensive than open surgery. Zhang et al showed that endoscopic release was associated with a significantly higher total mean cost per patient and physician fee, although the cost of occupational therapy may be less after surgery.[11] When performed in the operating room, ECTR costs $654 more than OCTR and $1,872 more when the OCTR is performed in the office, accounting for lost productivity due to missed work after surgery.[11] These authors did not, however, look at the cost of performing ECTR in the office under local anesthesia. Foster et al, however, looked at the mean hospital charge per procedure type and found that ECTR under local anesthesia saved about $419 compared with ECTR under general or regional anesthesia.[12] They also concluded that the cost of ECTR under local was $302 more than OCTR with general or regional anesthesia. Additionally, ECTR has been shown to have lower costs from a societal perspective, secondary to earlier return to work and quality-adjusted life years ($9,476 for ECTR in office vs $13,030 for OCTR in office).[13] When looking at the payer perspective, endoscopic release is significantly more expensive, unless performed under local anesthesia ($617 for ECTR in office vs $510 for OCTR in office).[13] These findings suggest that performing ECTR under local anesthesia may offset the cost from an overall societal perspective and for the patient. This, in combination with shorter operating times and faster time to discharge, can allow for better patient experience and increased surgical center efficacy. Cost per minute of ambulatory operating room time has been estimated at about $36 to $37, whereas postanesthesia care unit costs are around $11

to $12 per minute.[14,15] Considering the time savings calculated within our study population, this would equate to a cost savings of approximately $500 to $540 per patient based on operating room and postanesthesia care unit times alone. Additional cost savings in the local anesthesia group could result from staffing differences (as this group does not require the presence of an anesthesiologist, certified nurse anesthetist, or preanesthesia and postanesthesia nurses), as well as from obviating the need for an intravenous access, anesthesia medications, and other consumables.

When looking at outcomes, there were no significant differences in preoperative and postoperative PROMIS scores or complication and revision rates between the two groups. Taken together, the two groups had similar postoperative outcomes, which is consistent with what has been previously shown with OCTR. Tulipan et al[4] demonstrated that OCTR under local anesthesia had similar levels of patient satisfaction, reoperation rates, pain scores, and functional outcomes compared with MAC. Similarly, Aultman et al[6] compared both anesthetic and surgical techniques for CTR and found that there were minimal differences in opioid pain medication use, patient satisfaction, and pain scores when comparing MAC and local anesthesia and surgical technique. For all included patients undergoing local only procedure, vital signs were routinely monitored throughout the procedure. There were no episodes of case abortion due to pain, conversion to open, vasovagal episodes, or admission to a higher level of care. Patient satisfaction levels were not surveyed in this study. We did note, however, that of the 11 patients who underwent local only and needed to have a carpal tunnel procedure on the contralateral side, all 11 elected to undergo local only again, possibly indicating patient satisfaction with the procedure. Surgeon stress levels were not assessed, but the two surgeons (C.K.) included in the local group perform ECTR both under local anesthesia and MAC and note that local is their preferred technique.

Finally, the demographics of the two groups were overall similar, apart from the BMI, which was found to be significantly higher in the local group. Some patients who desire to undergo ECTR under MAC may not be candidates for the ambulatory center due to high BMI or other comorbidities and may elect to undergo either ECTR (or OCTR) under local anesthesia instead. ECTR, when performed under local anesthesia, obviates the need for preoperative testing and can be performed regardless of patient BMI or other health factors.

Our study has several limitations. Due to its retrospective nature, there was no longitudinal follow-up tracking of these patients. It is possible that some patients were lost to follow-up or might have had a complication treated at an outside institution. It is also important to note that the MAC and local techniques were utilized by a different group of surgeons, and the operative times and outcomes could be affected by other factors inherent to the individual surgeon's practice. Lastly, our study was conducted at a large urban tertiary care center within the Northeastern United States, and our results may not be generalizable. Nevertheless, the results from this study provide valuable information when considering anesthetic options during ECTR. Depending on patient factors and surgical center infrastructure, local anesthesia may result in considerable time and cost savings.

Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

References

1. Olney RK. Carpal tunnel syndrome: complex issues with a "simple" condition. *Neurology*. 2001;56(11):1431–1432.
2. Aroori S, Spence RA. Carpal tunnel syndrome. *Ulster Med J*. 2008;77(1):6–17.
3. Fajardo M, Kim SH, Szabo RM. Incidence of carpal tunnel release: trends and implications within the United States ambulatory care setting. *J Hand Surg Am*. 2012;37(8):1599–1605.
4. Tulipan JE, Kim N, Abboudi J, et al. Open carpal tunnel release outcomes: performed wide awake versus with sedation. *J Hand Microsurg*. 2017;9(2):74–79.
5. Chatterjee A, McCarthy JE, Montagne SA, Leong K, Kerrigan CL. A cost, profit, and efficiency analysis of performing carpal tunnel surgery in the operating room versus the clinic setting in the United States. *Ann Plast Surg*. 2011;66(3):245–248.
6. Aultman H, Roth CA, Curran J, et al. Prospective evaluation of surgical and anesthetic technique of carpal tunnel release in an orthopedic practice. *J Hand Surg Am*. 2021;46(1):69.e1–69.e7.
7. Shin EK. Endoscopic versus open carpal tunnel release. *Curr Rev Musculoskelet Med*. 2019;12(4):509–514.
8. Sayegh ET, Strauch RJ. Open versus endoscopic carpal tunnel release: a meta-analysis of randomized controlled trials. *Clin Orthop Relat Res*. 2015;473(3):1120–1132.
9. Abukhudair A, Mortada H, Alhindi N, et al. "Anesthesia for endoscopic carpal tunnel syndrome release: a comprehensive systematic review and meta-analysis of local versus regional versus general anesthesia." *JPRAS Open*. 2023;35:89–101.
10. Wellington I, Cusano A, Ferreira JV, Parrino A. WALANT Technique versus sedation for endoscopic carpal tunnel release. *Hand (N Y)*. 2023;18(2):214–221.
11. Zhang S, Vora M, Harris AH, Baker L, Curtin C, Kamal RN. Cost-minimization analysis of open and endoscopic carpal tunnel release. *J Bone Joint Surg Am*. 2016;98(23):1970–1977.
12. Foster BD, Sivasundaram L, Heckmann N, et al. Surgical approach and anesthetic modality for carpal tunnel release: a nationwide database study with health care cost implications. *Hand (N Y)*. 2017;12(2):162–167.
13. Barnes JI, Paci G, Zhuang T, Baker LC, Asch SM, Kamal RN. Cost-effectiveness of open versus endoscopic carpal tunnel release. *J Bone Joint Surg Am*. 2021;103(4):343–355.
14. Childers CP, Maggard-Gibbons M. Understanding costs of care in the operating room. *JAMA Surg*. 2018;153(4):e176233.
15. Raft J, Millet F, Meistelman C. Example of cost calculations for an operating room and a post-anaesthesia care unit. *Anaesth Crit Care Pain Med*. 2015;34(4):211–215.