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A Cost Analysis of Carpal Tunnel Release Surgery Performed Wide Awake versus under Sedation.

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25   **Financial Disclosures and Products**

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Abstract

Background: Hand surgery under local anesthesia only has been utilized more frequently in recent years. The purpose of this study was to compare perioperative time and cost for carpal tunnel release (CTR) performed under local anesthesia (WALANT) only to those performed under intravenous sedation (MAC).

Methods: A retrospective comparison of intra-operative (OR) surgical time and post-operative (PACU) time for consecutive CTR procedures performed under both MAC and WALANT was undertaken. All operations were performed by the same surgeon using the same mini-open surgical technique. A cost analysis was performed via standardized anesthesia billing based on base units, time, and conversion rates.

Results: There were no significant differences between the two groups in terms of total OR time, 28 minutes in the MAC group versus 26 minutes in the WALANT group. PACU times were significantly longer in the MAC group (84 minutes) compared to the WALANT group (7 minutes). Depending on conversion rates used, a total of \$139-\$432 was saved in each case done with WALANT by not using anesthesia services. In addition, a range of \$1,320-\$1,613 was saved for the full episode of care including anesthesia costs, OR time, and PACU time for each patient undergoing WALANT CTR.

Conclusions: CTR surgery performed with the WALANT technique offers significant reduction in cost utilization of anesthesia and PACU resources.

Introduction

Hand surgery performed under local anesthesia only without a tourniquet, also called “Wide Awake Local Anesthesia No Tourniquet” (WALANT) surgery, is a technique that is experiencing growing interest and utilization.[8,13-18,22,24] In WALANT surgery, surgical pain is controlled through an injection of a local anesthetic. The patient does not receive an intravenous or general anesthetic agent, thus eliminating the need for an anesthesia provider. There is minimal bleeding because the local anesthetic is supplemented with epinephrine, which limits bleeding within the operative field and negates the need and discomfort of a tourniquet. While there exists a widely accepted belief that use of epinephrine in distal extremities can cause finger necrosis, recent studies have demonstrated both the safety and efficacy of epinephrine utilization in the hand.[8,11,13-18,22,24,26-27]

Advocates for WALANT claim that this anesthetic method is safer as it eliminates standard anesthetic risks; is more convenient for the patient as it foregoes the need for pre-operative diagnostic testing, eliminates fasting, eliminates the need for a driver, avoids the discomfort of having an IV placed, foregoes anesthesia induction time in the operating room, and minimizes post-anesthesia care unit (PACU) recovery time. Another possible benefit of WALANT surgery is financial.[8,14-15] There are several potential cost savings from utilizing the WALANT technique rather than intravenous sedation with local (MAC). Areas worthy of economic comparison include the elimination of pre-operative testing (blood work, EKG and physician consultation for clearance for anesthesia), reducing and/or possibly eliminating the cost of an anesthesia provider and

the cost savings introduced by reducing the time patients need to spend in the operating room (OR) and PACU.

The purpose of this study was to perform an economic analysis of hand surgery utilizing a carpal tunnel release (CTR) surgery model, by comparing the facility costs of CTR surgery performed under WALANT versus those performed under MAC. The hypothesis was made that WALANT surgery would result in decreased hospital cost as compared to MAC surgery.

Materials and Methods

After receiving Institutional Review Board approval for retrospective review and analysis of patient records, a comparison of all CTR surgery performed between 2012-2015 were reviewed. All surgeries were performed by one fellowship-trained hand surgeon, at our outpatient surgical center. All procedures followed were in accordance with the ethical standards of the responsible institutional committee on human experimentation. The surgeon transitioned from performing all CTR surgeries under MAC to WALANT at the end of 2013. Therefore, consecutive CTR surgery performed between 2012-2013 with MAC were available for comparison with CTR cases in 2014-15 performed consecutively with the WALANT technique. Inclusion criteria were all “mini-open” CTR surgeries performed alone without concomitant procedures. Data points collected included: total OR time, surgical time, and PACU time, which were retrieved from the anesthesia record and nursing documentation. Anesthetic complications and re-operations were also recorded. These data points were compared and statistically analyzed using two-tailed T-tests.

Surgical Preparation

Both MAC and WALANT patients physically walked themselves into the operating room. Patients were positioned supine with their operative arm extended onto a hand table. A non-sterile tourniquet on the upper arm was applied to those undergoing MAC, while no tourniquet was applied in the WALANT group. Both groups underwent similar prepping and draping. There was no change in the surgical scrub, preparation, and draping during the study period.

Induction of Anesthesia

After prepping and draping the surgical site and after induction of anesthesia for the MAC cases, but prior to initiating surgery, 10cc of 1% lidocaine plain (without epinephrine), was injected into the surgical site. After injection but prior to making incision, the MAC group underwent Esmarch exsanguination the limb followed by insufflation of the tourniquet to 250 mmHg.

For patients undergoing WALANT, 9cc of 1% lidocaine with 1:100,000 epinephrine and 1cc of sodium bicarbonate were mixed. A total of 10cc of this mixture was injected into the surgical site upon entry into the operating room but prior to prepping and draping the patient.[19] Although it has been recommended to pre-inject the surgical site 20-30 minutes prior to injection in the pre-operative unit, it has been the practice of the senior author (AMI) to inject in the operating room prior to prepping and draping the patient with a negligible difference in bleeding and still no need for a tourniquet. An additional 10cc of 1% lidocaine with 1:100,000 epinephrine was available on the field for additional injection, as needed. Phentolamine, a reversal agent for the

vasoconstrictive effects of epinephrine, was available at all times in the surgical center but never needed to be utilized in any case.

Surgical Technique

The identical “mini-open” CTR surgical technique was utilized for both the MAC and WALANT cases. A 2cm longitudinal incision was placed at the base of the volar hand in line with the third web space. The superficial palmar fascia was cut in line with the skin incision. The transverse carpal ligament was identified and released longitudinally until complete decompression of the median nerve was confirmed. The skin incisions were closed with three horizontal mattress 4-0 nylon sutures followed by application of soft sterile dressing.

Cost Analysis

Anesthesia costs are calculated based on a base unit value assigned to the procedure based on its complexity added to the number of 15-minute time units the provider spends multiplied by the provider's charge per unit (i.e. conversion factor). The anesthesia clock starts when anesthesia personnel begin to prepare the patient for anesthesia care, and ends when the patient is safely placed in post-anesthesia supervision and anesthesia personnel are no longer in personal attendance. We used the 2017 Centers for Medicare and Medicaid Services (CMS) conversion rate of \$23.14 for our institution’s metropolitan area.[6] The anesthesia CPT code 01810 was used to determine 3 base units are applied to basic nerve decompression surgery of the hand. For each case done under WALANT a total of \$138.84 was saved by not using anesthesia services. Please see below for calculation.

$$\begin{aligned} & \text{[Base unit + Time (units)] x Conversion factor = Anesthesia charge} \\ & [3 \text{ units} + 3 \text{ units}] \times \$23.14/\text{unit} = \$138.84/\text{case} \end{aligned}$$

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139   Routine care provided to a patient in PACU and prior to discharge is not
140 separately billable to the Medicare Program. To evaluate the potential cost savings to the
141 hospital when WALANT surgery was used for CTR, we used \$12.16/minute that a
142 patient is in the PACU based on a 2015 study that evaluated detailed list of direct and
143 indirect costs needed rather than amount billed. We felt this would provide the best
144 estimate of potential cost savings to the hospital.[21]

145   Finally, to estimate standard costs for items associated with a routine pre-
146 operative testing associated with anesthesia we used figures publicly available from
147 healthcarebluebook.com. This database used averages of actual amounts paid by
148 insurance companies, including CMS, for common medical tests and services. The
149 standard preoperative testing consists of a history and physical, chest radiographs,
150 electrocardiogram, and standard bloodwork in the form of a complete blood count and
151 basic metabolic panel.

152 153 **Results**

154   A total of 190 patients met the inclusion criteria; 136 underwent sedation with
155 MAC and 54 patients with WALANT surgery. The average ages were 59 ± 14 and $62 \pm$
156 12 for MAC and WALANT groups, respectively. There were 86 females in the MAC
157 group (63%) and 24 in the WALANT group (44%). There were no anesthetic
158 complications or re-operations in either group.

159   As defined by the in-room and out-room time, patients in the MAC group had an
160 average total OR time of 28 ± 5.5 minutes, while the WALANT group averaged 26 ± 6.7
161 minutes ($p = 0.052$).

The surgical time, as defined by the documented procedure start and end time, averaged 9.7 ± 2.2 minutes in the MAC group while the WALANT group averaged 10 ± 2.3 minutes ($p = 0.41$).

Post-operatively, patients in the MAC group spent an average of 84 ± 29 minutes in the recovery room prior to discharge, compared to 7 ± 2 minutes in the WALANT group ($p < 0.05$) (Table 1).

As anesthesia reimbursement and individual patient insurance contracts differ, we used standard CMS reimbursement rates for anesthesia to determine cost differences. We estimated that each case performed under MAC had excess charges secondary to anesthesia reimbursement of approximately \$138.84 (See Methods for calculation). At a rate of \$12.16/minute,[21] with an average 84 minutes in the PACU, MAC cases cost an additional \$1,021.44 to the hospital. Furthermore, we estimate that patients scheduled for MAC had standard preoperative medical clearance and testing consisting of a history and physical (established patient 25 min visit: \$117), chest radiographs (\$47), electrocardiogram (\$22), and standard bloodwork in the form of a complete blood count (\$21) and basic metabolic panel (\$28).[9] The cost for these preoperative expenditures is \$235 per patient. Additionally, a pneumatic tourniquet cuff and 10cc of 1% lidocaine without epinephrine were used in each case, costing \$10[2] and \$4.[1]

Patients undergoing CTR under WALANT spent an average of 7 minutes in the PACU and thus assumed a cost of \$85.12 (\$12.16/minute). In each WALANT case, 20cc of 1% lidocaine with 1:100,000 epinephrine was used, costing an additional \$4.[1] The WALANT patients assumed a \$0 cost for all of the remaining preoperative and postoperative expenditures.

Combining the anesthesia cost, pre-operative clearance cost, tourniquet and lidocaine costs, and PACU costs, each patient performed under WALANT saved the healthcare system an average of \$1,320.16 (Table 2).

Discussion

Carpal Tunnel Syndrome is a common hand condition that is often treated with a CTR when surgery is indicated.[12] Perioperative anesthesia with sedation (MAC) or general anesthesia has traditionally been used for routine hand surgical procedures such as CTR. Recently, advances in WALANT technique has given surgeons and patients an additional method of administering anesthesia for routine hand surgical procedures such as CTR, thereby forgoing the need for anesthesia staff involvement and PACU recovery time.[14-15,18]

In our analysis of WALANT hand surgery performed in the treatment of carpal tunnel release surgery, we found no significant difference in the length of the procedure or in the total time spent in the operating room compared to the use of MAC. We speculate that the time spent by anesthesia to sedate the patient in the MAC group was matched by the time spent injecting local anesthetics by the surgeon in the WALANT group. ~~In addition, the similarity in length of procedure indicates that the epinephrine used in the WALANT group was as effective in controlling bleeding as the tourniquet in the MAC group.~~

Pre-operative nursing time was not measured. In general, patients in the MAC group would be expected to spend greater time in pre-op for IV placement and anesthesia evaluation, discussion, and consenting. Alternatively, patients in the WALANT group did

not require IV or anesthesia staff involvement. Conceivably, surgeons may request patients to present early to the pre-operative unit for injection of the surgical site as it is recommended to give the epinephrine 20-30 minutes to maximize the vasoconstrictive effect.[19] However, it is the practice of the senior author (AMI) to inject immediately pre-operatively in the operating room, prior to prepping the limb, without any increased issue of bleeding or need for a tourniquet. As such, for study purposes, we ignored the pre-operative time as that may be variable among surgeons. Regardless, had we studied this in our study we would have only found more time and cost in the MAC group.

Post-anesthesia care unit (PACU) times were significantly shorter in the WALANT group (7 ± 2 minutes) compared to the MAC group (84 ± 29 minutes). Because patients in the WALANT group do not receive systemic anesthetic agents, they do not require time to recover from their effects. An additional advantage for patients in the WALANT group is that they are allowed to drive themselves home following the procedure, and they therefore do not have to arrange for a ride.

The cost savings for each patient we found was \$1,320.16. This is an intentional, gross underestimation of the potential cost savings possible for WALANT CTR. Our anesthesia cost analysis was based on Medicare reimbursement schedules with no representation of the reimbursements of private insurers. We used the 2017 CMS conversion rate of \$23.14 for our institution's metropolitan area. Based on the 2015 American Society for Anesthesiologists (ASA) commercial conversion factor survey results, the national average conversion factor was \$71.92.[23] If we used this national average conversion rate, our cost savings would increase to \$431.52 for anesthesia services and \$1,612.84 total per patient. ~~Some premium insurance plans reviewed pay as~~

~~much as \$140/unit in major metropolitan areas.[23]~~ In addition, because PACU cost is not billed separately to insurance it is difficult to estimate the true cost. For this reason, we used the detailed cost analysis performed previously by Raft et al.[21] Because it is not based on billing charges, we feel this is the best estimate of actual cost (direct and indirect) saved by the hospital ~~but actually underestimates the final amount billed to the insurance company.~~

Codding et al. performed an economic analysis in which 78 consecutive cases of single trigger finger release surgery with MAC (31) were compared to those with WALANT (47).[7] Patients in the MAC group experienced an average OR time and surgical time of 27.2 and 10.2 minutes, respectively. Similarly, patients in the WALANT group experienced an average OR time and surgical time of 25.2 and 10.4 minutes, respectively. Average recovery room time was 72.3 and 30.2 minutes in the MAC and WALANT groups, respectively. This study reported an average savings of \$105 secondary to anesthesia reimbursement in MAC cases. However, while the average OR, surgical, and recovery room times were similar to our study, there was little detail on objective cost data (pre-op clearance, PACU, bloodwork, etc.) outside of anesthesia reimbursement, rendering the estimate of cost savings far less than reality.

Anesthesia is also associated with increased rates of nausea and vomiting. Twenty-six percent of patients require additional treatment in the PACU, and 40% of patients require additional treatment for post-operative nausea and vomiting (PONV) following discharge.[3-4] The cost of rescue treatment for PONV has been estimated at a minimum of \$283.[10] While we did not record PONV, this is an issue that can result in the need ambulance transfer to a hospital costing \$300 - \$900 and result in an admission

costing \$1,200 to more than \$2,400 per day. Additionally, an economic impact would also be seen in patients with obstructive sleep apnea (OSA). Studies show that 22-39% of all surgical patients are at high risk for OSA. 80% of these patients are undiagnosed.[28] During recovery, residual anesthetics increase the number and duration of sleep apnea episodes but inhibit arousals which would normally occur during such episodes. For this reason, the guidelines from the ASA for perioperative care of OSA patients suggest patients should stay in recovery for an extended period after the last episode (desaturation, reintubation, hypoxia, etc.). Eliminating these possible anesthetic complications completely further reduces budget for PACU time and cost. Finally, we evaluated the basic costs for a pre-operative visit and testing associated with clearance for anesthesia. Additional costs would be incurred for patients required to see a cardiologist or other specialist or if any further testing (echocardiogram, stress test, advanced lab work) was needed prior to surgery.

While there have been reports that use of epinephrine in distal extremities can cause finger necrosis,[29] these events appear to be extremely rare and recent studies have demonstrated both the safety and efficacy of epinephrine utilization in the hand. [8,11,13-18,22,24,26-27] In the senior author's personal experience of performing over 2000 cases under WALANT, there have been zero cases of digital ischemia or need for reversal. Nonetheless, it is good practice to keep phentolamine, a reversal agent for the vasoconstrictive effects of epinephrine, available at the surgical center where WALANT surgery is being performed.[20] There is an associated cost in ensuring that there is phentolamine (\$35 for 50 mg)[5] available that has not expired. However, as the use of phentolamine is extremely rare, it would have a negligible cost when spread out among

all WALANT cases occurring over the course of its shelf life. In addition, patients should be advised that they may feel jittery or shaky following injection but that this typically dissipates in 15-20 minutes.[14] This potential side effect requires no additional treatment and thus does not affect costs.

The purpose of the study was designed to investigate perioperative times and perform an economic analysis and comparison of CTR performed under MAC vs. WALANT. Therefore, no outcome measures, patient satisfaction scores, or follow-up data were collected. Several studies have, however, investigated such data in patients undergoing WALANT carpal tunnel release surgery. Davidson et al. found that 93% of patients who underwent WALANT surgery would choose it again in subsequent surgeries. In addition, it was found that patients' intraoperative anxiety for WALANT surgery was not significantly different than their preoperative anxiety. However, patients who underwent WALANT surgery had significantly less preoperative anxiety than patients who underwent sedation.[8] Teo et al. similarly found that 86% of patients who underwent WALANT surgery would choose it again in subsequent surgeries. Additionally, 91% reported that the operation was less painful or comparable with a procedure at the dentist.[25]

Our study has some limitations. First, it is a retrospective study that is based solely on the experiences of a single surgeon at a single institution. Multi-center, prospective, randomized trials could build upon our data and provide further insight into use of the WALANT method. As previously noted, this study was not designed to investigate outcomes or patient satisfaction and thus lacks any clinical data. In addition, the costs assumed by hospitals, patients, and insurance companies vary significantly and

often are difficult to dissect on an item-by-item basis. This study aims to address costs to the hospital, but payer reimbursements often were used in their place when sufficient data was unavailable, which may affect the accuracy of our cost estimates.

In conclusion, patients who underwent carpal tunnel release surgery under WALANT demonstrated similar time in the operating room and similar surgical time from incision to closure compared to sedation with MAC. Patients in the WALANT group also spent significantly less time in the PACU post-operatively, saving approximately \$1,320.16 per patient, which certainly underestimates the total savings. Avoiding use of anesthesia services for high volume procedures like carpal tunnel release surgery may result in significant systemic annual savings to payers and hospitals. These savings may be desirable with the growth of bundling and episode-based payments to patients, facilities, and surgeons.

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380   **Legend**

381   Table 1 – Comparison of time variables for MAC vs. WALANT.

382   Table 2 – Cost comparison for MAC vs. WALANT.