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

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1 **TITLE:**

2 **A Cost Analysis of Carpal Tunnel Release Surgery Performed Wide Awake versus**
3 **under Sedation**

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28 **Abstract**

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

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

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

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

47 **Introduction**

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

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

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

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

76

77 **Materials and Methods**

78 After receiving Institutional Review Board approval for retrospective review and
79 analysis of patient records, a comparison of all CTR surgery performed between 2012-
80 2015 were reviewed. All surgeries were performed by one fellowship-trained hand
81 surgeon, at our outpatient surgical center. All procedures followed were in accordance
82 with the ethical standards of the responsible institutional committee on human
83 experimentation. The surgeon transitioned from performing all CTR surgeries under
84 MAC to WALANT at the end of 2013. Therefore, consecutive CTR surgery performed
85 between 2012-2013 with MAC were available for comparison with CTR cases in 2014-
86 15 performed consecutively with the WALANT technique. Inclusion criteria were all
87 “mini-open” CTR surgeries performed alone without concomitant procedures. Data
88 points collected included: total OR time, surgical time, and PACU time, which were
89 retrieved from the anesthesia record and nursing documentation. Anesthetic
90 complications and re-operations were also recorded. These data points were compared
91 and statistically analyzed using two-tailed T-tests.

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Surgical Preparation

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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.

99

Induction of Anesthesia

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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.

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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

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

116 Surgical Technique

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

124 Cost Analysis

125 Anesthesia costs are calculated based on a base unit value assigned to the
126 procedure based on its complexity added to the number of 15-minute time units the
127 provider spends multiplied by the provider's charge per unit (i.e. conversion factor). The
128 anesthesia clock starts when anesthesia personnel begin to prepare the patient for
129 anesthesia care, and ends when the patient is safely placed in post-anesthesia supervision
130 and anesthesia personnel are no longer in personal attendance. We used the 2017 Centers
131 for Medicare and Medicaid Services (CMS) conversion rate of \$23.14 for our
132 institution’s metropolitan area.[6] The anesthesia CPT code 01810 was used to determine
133 3 base units are applied to basic nerve decompression surgery of the hand. For each case
134 done under WALANT a total of \$138.84 was saved by not using anesthesia services.
135 Please see below for calculation.

136 **[Base unit + Time (units)] x Conversion factor = Anesthesia charge**
137 [3 units + 3 units] x \$23.14/unit = \$138.84/ case

138
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 ($p = 0.052$).

162 The surgical time, as defined by the documented procedure start and end time,
163 averaged 9.7 ± 2.2 minutes in the MAC group while the WALANT group averaged $10 \pm$
164 2.3 minutes ($p = 0.41$).

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

168 As anesthesia reimbursement and individual patient insurance contracts differ, we
169 used standard CMS reimbursement rates for anesthesia to determine cost differences. We
170 estimated that each case performed under MAC had excess charges secondary to
171 anesthesia reimbursement of approximately \$138.84 (See Methods for calculation). At a
172 rate of \$12.16/minute,[21] with an average 84 minutes in the PACU, MAC cases cost an
173 additional \$1,021.44 to the hospital. Furthermore, we estimate that patients scheduled for
174 MAC had standard preoperative medical clearance and testing consisting of a history and
175 physical (established patient 25 min visit: \$117), chest radiographs (\$47),
176 electrocardiogram (\$22), and standard bloodwork in the form of a complete blood count
177 (\$21) and basic metabolic panel (\$28).[9] The cost for these preoperative expenditures is
178 \$235 per patient. Additionally, a pneumatic tourniquet cuff and 10cc of 1% lidocaine
179 without epinephrine were used in each case, costing \$10[2] and \$4.[1]

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

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

188

189 **Discussion**

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

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

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

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

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

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

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

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

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

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

267 While there have been reports that use of epinephrine in distal extremities can
268 cause finger necrosis,[29] these events appear to be extremely rare and recent studies
269 have demonstrated both the safety and efficacy of epinephrine utilization in the hand.
270 [8,11,13-18,22,24,26-27] In the senior author's personal experience of performing over
271 2000 cases under WALANT, there have been zero cases of digital ischemia or need for
272 reversal. Nonetheless, it is good practice to keep phentolamine, a reversal agent for the
273 vasoconstrictive effects of epinephrine, available at the surgical center where WALANT
274 surgery is being performed.[20] There is an associated cost in ensuring that there is
275 phentolamine (\$35 for 50 mg)[5] available that has not expired. However, as the use of
276 phentolamine is extremely rare, it would have a negligible cost when spread out among

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

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

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

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

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

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313

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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.