Comparing the outcome of monitored anaesthesia care and local anaesthesia for carpal tunnel syndrome surgery by neurosurgeons

Goh Chin Hwee, MS[1], Lau Bik Liang, MD[1], Teong Sook Yee, MD[1], Law Wan Chung, MRCP[2], Tan Peter Chee Seong, MMED[3], Ravindran Vashu, FRCS[1], Liew Donald Ngian San, FRACS[1], Wong Albert Sii Hieng, FRACS[1]

[1]Department of Neurosurgery, Sarawak General Hospital, Kuching, Sarawak, [2]Neurology unit, Department of Internal medicine, Sarawak General Hospital, Kuching, Sarawak, [3]Department of Anaesthesiology and intensive care, Sarawak General Hospital, Kuching, Sarawak

ABSTRACT

Introduction: Carpal tunnel syndrome (CTS) is the commonest median nerve entrapment neuropathy of the hand, up to 90% of all nerve compression syndromes. The disease is often treated with conservative measures or surgery. The senior author initially intended to treat his own neurosurgical patients concurrently diagnosed with carpal tunnel syndrome in 2014, subsequently, he began to pick up more referrals from the primary healthcare group over the years. This has led to the setup of a peripheral and spine clinic to act as a hub of referrals. Objective: Department of Neurosurgery Sarawak aimed to evaluate the surgical outcome of carpal tunnel release done over five years.

Methods: The carpal tunnel surgeries were done under local anaesthesia (LA) given by neurosurgeons (Bupivacaine 0.5% or Lignocaine 2%). Monitored anaesthesia care (MAC) was later introduced by our hospital neuroanaesthetist in the beginning of 2018 (Target-controlled infusion propofol and boluses of fentanyl). We looked into our first 17 cases and compared these to the two anaesthesia techniques (LA versus MAC + LA) in terms of patient's pain score based on visual analogue scale (VAS).

Results: Result showed MAC provided excellent pain control during and immediately after the surgery. None experienced anaesthesia complications. There was no difference in pain control at post-operation one month. Both techniques had equal good clinical outcome during patients' clinic follow up.

Conclusion: Neurosurgeons provide alternative route for CTS patients to receive surgical treatment. Being a designated pain free hospital, anaesthetist collaboration in carpal tunnel surgery is an added value and improves patients overall experience and satisfaction.

KEY WORDS:
Carpal tunnel syndrome, median nerve entrapment, mononeuropathy, carpal tunnel surgery, monitored anaesthesia care

INTRODUCTION

Carpal tunnel syndrome (CTS) is the commonest median nerve entrapment neuropathy of the hand, up to 90% of all nerve compression syndromes. In Malaysia, local literature has reported its prevalence at a range of 20-60%.[1,2] It is a peripheral nerve disease that is self-limiting or may resolve with conservative measures including wrist splinting, physiotherapy, medications and lifestyle modification. However, worsening and progressive symptoms can be relieved through a simple surgery - transverse carpal ligament release, either open or endoscopically. Neurosurgery is a subspecialty that is equipped to treat a wide range of nervous system disorders encompasses brain, spinal cord and peripheral nerves. The frequent occurrence of CTS among neurosurgical patients with spine diseases or acromegaly has led to the notion of initiating carpal tunnel surgery service for the small group. This was much later expanded and opened to the public through a dedicated clinic to receive referrals from the primary healthcare.

OBJECTIVES

The aim was to look into the surgical outcome of carpal tunnel syndrome cases operated in the Department of Neurosurgery, Sarawak General Hospital, Kuching, Sarawak and to compared the two anaesthesia techniques used in the surgery.

MATERIALS AND METHODS

Patient selection

All patients that were diagnosed with carpal tunnel syndrome in the neurosurgery clinic at the Sarawak General Hospital, Kuching, Malaysia from 2014 to 2018 were included in the study. These cases were confirmed with electrophysiological test; nerve conduction study conducted by neurologist. All the patients had gone through conservative measures and physiotherapy for at least six weeks to three months prior to surgical option.

This article was accepted: 24 May 2019
Corresponding Author: Dr. Goh Chin Hwee
Email: shencity@yahoo.com

Nerve conduction study
An 8- and 2- channel (AT2 & AT2+6) CareFusion Nicolet EDX (Synergy system) with two types of electrical stimulator probes (RS10 & WR50) was used. Motor and sensory studies were performed for median and ulnar nerves. The sensory and motor components were stimulated in antidromic and orthodromic manner respectively. F wave was recorded. Action potentials were recorded as sensory nerve action potential (SNAP) and compound muscle action potential (CMAP). The parameters obtained were latency (ms), amplitude (mV for motor, µV for sensory), distance (cm) and conduction velocity (m/s). We graded the severity of CTS based on criteria adopted from Padua and Bland, which consisted of seven grades (very mild to very severe).

Local anaesthesia (LA) or Monitored anaesthesia care (MAC)
All the operative local anaesthesia was handled by the attending neurosurgeon initially. This was until the beginning of 2018 when our hospital neuroanaesthetist introduced MAC to facilitate the surgery.

Patients in LA group received 10cc of Marcaine 0.5% or Lignocaine 2% or combination of both in 5cc each, into the surgical site after draping. Additional 5 to 10cc of LA was then injected when necessary during the surgery. Techniques were discussed and standardised during preop meeting.

Patients in MAC group were sedated with propofol via a target-controlled infusion (TCI) pump set to a rate of 1-2µg/ml and boluses of fentanyl 50-100µg. A 10cc of Marcaine 0.5% or Lignocaine 2% was infiltrated into the surgical site before skin incision.

Surgery
Surgery began with linear incision made at the junction between Kaplan cardinal line and third webspace. This incision was extended till the distal palmar wrist crease. Under a 3.5x surgical loupes visual guide, sharp dissection done in layers until the transverse carpal ligament. The wound opening was retracted by using either Alm's or mini Weitlaner retractor. A size 15 blade was utilised to incise the ligament with a McDonald's dissector slit under it. The dissector acted as a guide for the blade's cutting direction and to protect neural structure and tendons beneath the ligament. Once the ligament was completely released, the dissector was probed proximally and distally to confirm both ends were being freed.

Statistical analysis
IDM SPSS version 24 was utilised to describe and analyse sociodemographic data, visual analogue scale (VAS) and choice of anaesthesia.

RESULTS
We had 14 patients diagnosed with CTS. Twelve were females and two were males. Age of the patients ranged from 22 to 67 years. Majority of them were 50-59 age group with equal racial distribution (Table I). Numbness was the commonest clinical presentation, followed by hand weakness, atrophy and pain. Positive Tinel sign (70.8%) was more commonly seen in CTS than Phalen's test (54.2%) (Table II). All the patients were right hand dominant, except one. CTS predominantly affected right hand in nine out of 14 patients, either single (28.6%) or bilateral (35.7%) disease (Table II). Majority of the patients were housewives, accounting for 50%. Other patients were farmers, cooks, cleaners, students and administrative officers. Many were overweight and obese based on the body mass index (BMI) (83.3%). Mean BMI of female was 2.6 slightly higher than male, with BMI of 29.0 and 26.4 respectively. The female group was associated with other known risk factors, including diabetes mellitus, acromegaly and oral contraception.

Nerve conduction studies confirmed 24 carpal tunnel syndrome hands in 14 patients. Ten were grade I to II (severe and very severe), ten were grade III to IV (moderate and moderate to severe), four were grade V to VI (mild and mild to moderate), and four were normal. We found the worse electroneurophysiological findings in right hand. Distal latency was significantly prolonged in both motor and sensory tests, by a discrepancy of 0.9ms and 1.1ms in the latter. Its mean conduction velocity was also severely reduced and recorded at rate of 49.8m/sec. Moreover, conduction test was not recordable in two right hands (Table III).

We conducted 17 CTS surgery on 14 patients, of which 11 were right hands and six were left hands. Most of the hands were graded at least moderate severity and above (82%). Twelve cases were done under LA by neurosurgeon. The other five cases were done under monitored sedation with LA introduced by neuroanaesthetist. Through this technique, all the five patients experienced no intraoperative pain. Two had VAS pain score of one at 24 hours after the surgery and one had pain score of one at one month. In the LA only group, all the 12 patients experienced pain with mean VAS pain score of 4.7, which improved postoperatively to 1.42 at 24 hours and 0.2 at one month (Figure 1). There was significant difference in intraoperative pain between the two anaesthetics choice (p=0.001) (Table IV). There were no other complications observed in both groups. Surgery duration was comparable between the two groups with majority completed within 60 minutes. Hospital stay duration was not included in this study because some of the patients requested to stay overnight postoperatively due to logistic reason.

DISCUSSION
Carpal tunnel syndrome (CTS) is the commonest median nerve entrapment mononeuropathy of the hand, up to 90% of all nerve compression syndromes.[3,4] Symptoms often include numbness and tingling sensation in the hands, occasionally associated with pain which is relieved by shaking or dangling the wrist. Small muscles of hand weakness and thenar eminence wasting can be seen in severe condition.[5] CTS is a chronic disease with long duration of time course. Acute condition is uncommon and usually is accounted by artery thrombosis or haematoma. CTS classically has two stages. First stage symptoms predominantly are pain or numbness. Patients often awake during the night with tingling or painful sensation in their hand, termed brachialgia paraesthetica nocturna. The second stage is when thenar eminence atrophy becomes

Table I: Demographic and risk factors of Carpal Tunnel Syndrome in 14 patients

Risk factors	Male	Female
Sex, n, (%)	2 (14.3)	12 (85.7)
Race, n, (%)		
Malay	1 (50.0)	3 (25.0)
Chinese	1 (50.0)	3 (25.0)
Iban	0	5 (41.7)
Others	0	1 (8.3)
Occupation		
Housewife	0	6 (50.0)
Others	2 (100.0)	6 (50.0)
BMI, mean, SD	26.4±3.3	29.0±3.7
Underweight (<18.5)	0	0
Normal (18.5-24.9)	1 (50.0)	2 (16.7)
Overweight (25-29.9)	1 (50.0)	5 (41.7)
Obese I (30-34.9)	0	4 (33.3)
Obese II (35-39.9)	0	1 (8.3)
Obese III (>/= 40)	0	0
Smoking, n, (%)		
Yes	0	0
No	2 (100.0)	12 (100.0)
Diabetes mellitus, n, (%)		
Yes	0	4 (33.3)
No	2 (100.0)	7 (58.3)
Acromegaly, n, (%)		
Yes	0	2 (16.7)
No	2 (100.0)	9 (83.3)
Hypothyroidism, n, (%)		
Yes	0	0
No	2 (100.0)	12 (100.0)
Oral contraceptive pill, n, (%)		
Yes	0	1 (8.3)
No	2 (100.0)	11 (91.7)
Pregnancy, n, (%)		
Yes	Not applicable	0
No		12 (100.0)
Parity, mean, SD	Not applicable	2.6±1.3
Dominant hand		
Right	2 (100.0)	11 (91.7)
Left	0	1 (8.3)
Ambidextrous	0	0

Table II: Clinical presentation of Carpal Tunnel Syndrome patients.

Presentation	Frequency (n, %)
Symptoms and Signs	
Numbness/ Paraesthesia	24, 100.0%
Nocturnal pain or diurnal pain	3, 12.5%
Hand weakness	18, 75.0%
Hand muscle wasting	15, 62.5%
Tinel sign	17, 70.8%
Phalen sign	13, 54.2%
Laterality	
Right only	4, 28.6%
Left only	0
Bilateral, more on right	5, 35.7%
Bilateral, more on left	5, 35.7%
Bilateral, equal	0

Table III: Nerve conduction study (median nerve) in Carpal Tunnel Syndrome patients

Median nerve	Right hand (mean (SD), range)	Left hand (mean(SD), range)
N 12*	10**	
Latency (ms)	5.6(1.8), 3.0-9.6	4.7(1.6), 2.5-8.9
Amplitude (mV)	6.7(2.9), 1.5-10.6	6.0(2.9), 1.7-10.8
Conduction velocity (m/sec)	49.8(3.8), 44.5-56.8	55.8(9.0), 46.8-75.9
F wave (ms)	30.0(2.4), 26.2-33.2	28.6(2.0), 25.7-31.3
Sensory peak amplitude (μV)	11.3(6.6), 5.4-21.8	21.6(13.0), 6.4-54.5
Sensory latency (ms)	4.4(1.4), 2.9-7.5	3.5(0.6), 2.2-4.3

Note: SD – Standard Deviation, ms – millisecond, mV – millivolt, μV – microvolt, m/sec – metre per second
*=2 hands were not recordable; **=4 hands were normal in nerve conduction study

Table IV: Seventeen cases of Carpal Tunnel Syndrome surgery categorised into Monitored anaesthesia care (MAC) + Local anaesthesia (LA) and LA only

	MAC + LA (n=5) n(%)	LA (n=12) n(%)	P-value
Hands			
Right	4 (80.0)	7 (58.3)	
Left	1 (20.0)	5 (41.7)	
CTS severity grade			
I Very severe	1 (20.0)	3 (25.0)	
II Severe	2 (40.0)	0	
III Moderate to severe	1 (20.0)	1 (8.3)	
IV Moderate	0	6 (50.0)	
V Mild to moderate	1 (20.0)	0	
VI Mild	0	2 (16.7)	
VII Very mild	0	0	
Surgery duration (min)			0.958
mean, (SD)	49.6(15.5)	46.3(10.5)	
0-30	0	2 (16.7)	
31-60	4 (80.0)	10 (83.3)	
>60	1 (20.0)	0	
Intraoperative pain			0.001
mean, SD	0	4.7(1.6)	
Yes	0	12 (100.0)	
No	5 (100.0)	0	
Postoperative pain 24 hours			0.070
mean, SD	0.4(0.5)	1.42(1.1)	
Yes	2 (40.0)	9 (75.0)	
No	3 (60.0)	3 (25.0)	
Postoperative pain 1 month			0.873
mean, SD	0.2(0.4)	0.2(0.4)	
Yes	1 (20.0)	2 (16.7)	
No	4 (80.0)	10 (83.3)	
Postoperative numbness			
Yes	0	0	
No	5 (100.0)	12 (100.0)	
Postoperative complication			
Headache	0	0	
Giddiness	0	0	
Nausea & vomiting	0	0	
Allergic reaction	0	0	
Infected wound	0	0	
Wound breakdown	0	0	

Note: SD – Standard Deviation

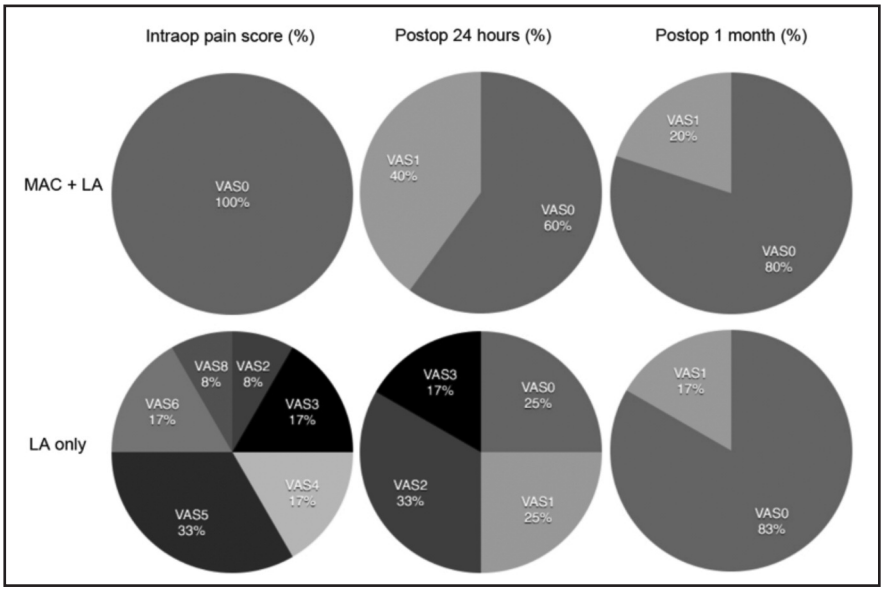

Fig. 1: VAS pain score Monitored anaesthesia care (MAC) + Local anaesthesia (LA) vs. LA only.

apparent. Other affected small muscles of hand include abductor pollicis brevis, opponens pollicis and lumbricals. In this phase, sensory symptoms may become diminished. CTS is closely associated with various known risk factors, particularly job-related trauma in which repetitive and forceful movement of hand and wrist or use of hand-held motorised, vibratory tools.[3,4,6] Other risk factors are medical and physiological conditions. These include pregnancy, obesity, drug toxicity, alcoholism, diabetes, hypothyroidism, rheumatoid arthritis, primary amyloidosis, acromegaly.[3,4,7] The disease is diagnosed by constellation of clinical signs, notably positive Tinel's sign and numbness of lateral three and a half digits (the palmar side of thumb, index, middle finger and the radial side of the ring finger). It is also correlated with electrophysiological findings of delayed nerve conduction and electromyography findings of denervation in moderate or severe case.[8] Other clinical neurophysiologic evaluations are available but less sensitive due to its subjective components. These techniques are vibrometry threshold testing, current perception testing, symptom questionnaire (hand diagrams) and Semmes-Weinstein monofilament testing.[7] Britz et al., advocated the use of magnetic resonance imaging (MRI) in diagnosis and prognosis. He found that restoration STIR signal in median nerve predicted more favourable outcome after surgery.[9] MRI is also an excellent tool to detect rare pathological causes of CTS such as ganglion or haemangioma.[10] Ultrasound has been implicated as an alternative to gold standard nerve conduction study (NCS) in diagnosis of CTS. Through clinical study, despite the equal sensitivities, it is recommended as an adjunct to NCS.[11] The treatment of CTS ranges from conservative measures in mild symptoms to surgery in moderate to severe symptoms. Surgical release of transverse carpal ligament provides excellent long-term outcomes and symptom relief in majority, approximately 70-90%.[12] Padua et al., followed up 274 conservatively treated idiopathic CTS over a period of 10-25 months. He reported symptoms alleviation in 35% and static in 45%. However, 68% of patients experienced limitations in their work and hobbies.[13] It is a disease that is commonly presented to rheumatologists and orthopaedic hand clinicians. Similarly, in Malaysia, CTS surgery is performed by orthopaedic surgeons due to historical accounts. Neurosurgery was only established much later in late 1960's in Malaysia.[14] The high prevalence of CTS and overlapping symptoms of cervical spondylosis or other neurological conditions eventually have led to referral to neurosurgeon. This is the same situation encountered in Sarawak.

Despite cranial surgeries being neurosurgeon's major core in Malaysia, we also provide comprehensive care for conditions of the peripheral nerve and spine, even though being fairly novel to specialty in terms of service provider. The existing outpatient clinic set up by senior author functions as a hub to receive referrals and walk-in cases. Upon clinical diagnosis of CTS by neurosurgeon, neurologist will confirm the diagnosis via nerve conduction study. We then engage rehabilitation unit to initiate non-surgical measures including physiotherapy exercises. Clinical symptoms will be reviewed in subsequent clinic follow ups. Surgery is offered when indicated during patient-surgeon discussion. The recruitment of anaesthetist into the multidisciplinary team bestows an added value to patient's peri- and intra-operative experience. This is also a collaborative effort of the hospital to be accredited as pain free institution. The opportunity of having anaesthetic technique choices enables our group to work towards the goal of achieving better patient pain control experience. Anaesthetic options can be tailored to patients within the measures of risk and benefits. We are still in the midst of improvising the LA regime considering cases may not be suitable for MAC at all time. Wrist block is also taken into account in future cases. Rehabilitation unit plays crucial role post-operatively in hand rehabilitation through series of structured modules. With the joint effort from dedicated neurology, rehabilitation and neuroanaesthesiology unit, we have achieved overall good satisfactory and positive feedbacks from our very first batch of patients.

CONCLUSION

Neurosurgeons render alternative channel for CTS patients to receive surgical treatment in conjunction with the conventional orthopaedic service. Anaesthetist collaboration in monitored anaesthesia care has given additional option to improve the patient's overall outcome and experience.

REFERENCES

1. Munira MA, Normastura AR, Azizah Y, Aziah D. Prevalence of probable carpal tunnel syndrome and its associated factors among dentist in Kelantan. Int J Coll Res Int Med Public Health. 2014; 6(8): 247-59.
2. Tamrin SB, Zakaria NS. The prevalence of carpal tunnel syndrome among counter workers in telecommunication company. Malays J Hum Factors Ergon. 2016; 1(1): 68-76
3. Yunoki M, Kanda T, Suzuki K, Uneda A, Hirashita K, Yoshino K. Importance of recognizing carpal tunnel syndrome for neurosurgeons: a review. Neurol Med Chir (Tokyo) 2017; 57: 172-83.
4. Ibrahim I, khan WS, Goddard N, Smitham P. Carpal tunnel syndrome: a review of the recent literature. Open Orthop J 2012; 6: 69-76.
5. Tachibana S. Surgical therapy for entrapment neuropathy. Clin Neurol 2012; 52: 840-3.
6. Chell J, Stevens A, Davis T. Work practices and histopathological changes in the tenosynovium and flexor retinaculum in carpal tunnel syndrome in women. J Bone Joint Surg Br 1999; 81: 868-70.
7. Werner RA, Andary M. Carpal tunnel syndrome: pathophysiology and clinical neurophysiology. Clin Neurophysiol 2002; 113(9): 1373-81.
8. Cseuz KA, Thomas JE, Lambert EH, Love JG, Lipscomb PR. Long-term results of operation for carpal tunnel syndrome. Mayo Clin Proc 1966; 41:232-41.
9. Britz GW, Haynor DR, Kuntz C, Goodkin R, Gitter A, Kliot M. Carpal tunnel syndrome: correlation of magnetic resonance imaging, clinical, electrodiagnostic, and intraoperative findings. Neurosurgery 1995; 37(6): 1097-103.
10. Cudlip SA, Howe FA, Clifton A, Schwartz MS, Bell BA. Magnetic resonance neurography studies of the median nerve before and after carpal tunnel decompression. J Neurosurg 2002; 96: 1046-51.
11. Mondelli M, Filippou G, Gallo A. Diagnostic utility of ultrasonography versus nerve conduction studies in mild carpal tunnel syndrome. Arthritis Rheum 2008; 59: 357-66.
12. Turner A, Kimble F, Gulyas K, Ball J. Can the outcome of open carpal tunnel release be predicted?: a review of the literature. ANZ J Surg 2010; 80: 50-4.
13. Padua L, Padua R, Aprile I, Pasqualetti P, Tonali P; italian CTS Study Group. Multiperspective follow-up of untreated carpal tunnel syndrome: a multicenter study. Neurology 2001; 12: 1459-66.
14. Raffiq A, Abdullah JM, Haspani S, Adnan JS. History of neurosurgery in Malaysia. Malays J Med Sci 2015; 22: 5-8.