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Questioning the use of tourniquets in carpal tunnel surgery and determining ideal level

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Abstract

Our aim was to determine if tourniquet use was a requirement in CTS release surgery, by evaluating patients in which tourniquets were used at different levels and patients in which tourniquets were not used during surgery. A total of 48 patients were included in the study. Eighteen patients had bilateral carpal tunnel syndrome. In these patients, the surgery of one side was performed with a forearm tourniquet, while the other side was performed with the conventional upper arm tourniquet. Thirty patients underwent carpal tunnel release surgery without a tourniquet. The duration of surgery, heart rate, blood pressure, pain status (visual analogue scale) of all patients, and the blood loss of patients who underwent surgery without a tourniquet were recorded. When the tourniquet and no-tourniquet groups were compared, there were no significant differences in terms of pain and physiological response. However, patient satisfaction was higher in the no-tourniquet group while operation times were longer. We believe that the local anesthetic + epinephrine without tourniquet method is advantageous compared to the other methods.

Keywords: Carpal tunnel surgery, tourniquet

Introduction

First defined in 1854 by Sir James Paget, carpal tunnel syndrome (CTS) is the most common entrapment neuropathy. It is caused by compression of the median nerve. Many factors have been identified that cause CTS. These include; abnormalities in carpal bones, fractures, post-trauma arthritides, local tumors, diabetes mellitus, rheumatoid arthritis, and pregnancy [1]. Five important criterions are involved in determining treatment approach: age (>50 years), duration of symptoms (>10 months), constant paresthesia, stenosing flexor tenosynovitis, and phalen test positivity in less than 30 seconds. It is accepted that two-thirds of patients who do not fulfill any of these conditions can be treated with conservatively. If 4 or more are present, surgical treatment is required [2].

The aim of the surgery is to release the transverse carpal ligament. This procedure is performed with local anesthesia and is carried out as an outpatient procedure. Tourniquets may be used to ensure a bloodless surgical area which may be required in hand surgery. It is possible to obtain the same bloodless surgical area via addition of epinephrine into the local anesthetic [3].

Various tourniquet types have been used in surgeries, such as esmarch, pneumatic, and silicone ring tourniquets. Esmarch tourniquet is no longer used due to its high pressure which causes skin and nerve injury. Pneumatic tourniquets have enhanced safety and cause lesser complications if used appropriately. Tourniquet pain is a problem which worries both the surgeon and anesthesiologist. The local effects of tourniquets are due to simple mechanic compression; however, they also cause systemic effects. The mechanism of tourniquet pain is rather complex. While compression of muscles causes the activation of nociceptors, hypoxia may also increase the sensitivity of nociceptors to mechanic compression [4]. After a tourniquet is placed, progressive cellular hypoxia and acidosis develops. The muscles are much more sensitive to this effect compared to the nerves. Tourniquet pain may develop in up to 66% of patients during surgery [5]. Tourniquets also increase blood pressure in 11-66% of patients [6].

The criteria for safe tourniquet use was determined by Bruner and modified by Barithwaite and Klenerman. In order to ensure safe tourniquet use, the tourniquet must be at least 10 cm's wide and the pressure must be 200-250 mm Hg or 50-100 mm Hg higher than systolic pressure [7].

Our aim was to determine if tourniquet use was a requirement in CTS release surgery, by evaluating patients in which tourniquets were used at different levels and patients in which tourniquets were not used during surgery.

Material and Methods

Among patients who were operated on due to carpal tunnel syndrome between 2011-2017, eighteen bilateral-CTS patients who underwent surgery with tourniquets and 30 patients who underwent surgery without tourniquets were included in the study. Fourteen of the 18 bilateral CTS patients were female, 4 were

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male and mean age was 56.4 (54-62) years. Twenty-two of the 30 unilateral-CTS patients were female, 8 were male and mean age was 58.6 (52-64) years.

The patients with bilateral CTS received surgery at different times for each arm; the release surgery of one side was performed with a forearm tourniquet, while the other side was performed with an upper arm tourniquet. Among the no-tourniquet patients, 15 received local anesthetic + epinephrine, while the remaining 15 received only local anesthetic. None of the patients were given anxiolytics or sedatives.

Groups were defined as follows. Group 1: upper arm tourniquet, Group 2: forearm tourniquet, Group 3: only local anesthesia without tourniquet, Group 4: local anesthesia + epinephrine without tourniquet.

The modified Bruner criteria were followed in patients who received tourniquets. In all patients, tourniquet pressure was 75 mm's higher than systolic pressure. Forearm tourniquet was placed 6 cm's proximal to the wrist. Operation duration, heart rate and blood pressure were monitored. The amount of blood loss was recorded in no-tourniquet patients. After pressurization of the tourniquet, pain was assessed 3 times via VAS, the first at 2.5 mins, second at 5 mins, and third at 10 mins. In surgeries which ended before 10 minutes, the last assessment was made right before the tourniquet was de-pressurized.

Results

In patients who received tourniquets, mean time with upper-arm tourniquet was found as 9.5 minutes (8-11), and mean time with forearm tourniquet was 10.11 (8-12) minutes. A bloodless surgical area was successfully obtained with both tourniquet methods (Group 1 and 2). In group 3 (only local anesthetic without tourniquet) the amount of blood loss was enough to completely soak a 4x4 gauze (8-10 ml). Partial bleeding was observed in the surgical area. In Group 4 (local anesthetic + epinephrine without tourniquet), an almost-bloodless surgical area was obtained with minimal bleeding. Tourniquet duration was slightly longer in Group 2 and the fingers of these patients were in flexion due to the tendons being strained by the tourniquet. In terms of heart rate and blood pressure, we did not find any significant changes in any of the groups. Time-dependent changes in the VAS scores of Group 1 and 2 are shown in Table 1 and Figure 1. No significant associations were found between group and time variables (p=0.101). When intra-group values were compared, VAS scores were found to increase with time in both Group 1 and 2 (p<0.001). Finally, when the 2.5-, 5- and 10-minute VAS scores were compared between groups, there were no significant differences for 2.5- and 5-minute VAS; however, 10-minute VAS score was significantly higher in Group 1 compared to Group 2 (p=0.001).

Mean VAS scores of Groups 3 and 4 and time-dependent changes are shown in Table 2 and Figure 2. When time-dependent intra-group values were compared, we found that the 2.5-minute VAS score was higher than 5- and 10-minute VAS scores in Group 3 (p<0.001), there was no difference between 5- and 10-minute VAS scores. The same was also found in Group 4; 2.5-minute VAS score was significantly higher than 5- and 10-minute VAS scores (p<0.001) and again, there was no difference between 5- and 10-minute VAS scores. We did not find any significant differences between groups when VAS scores at each time point were compared with each other (p>0.05).

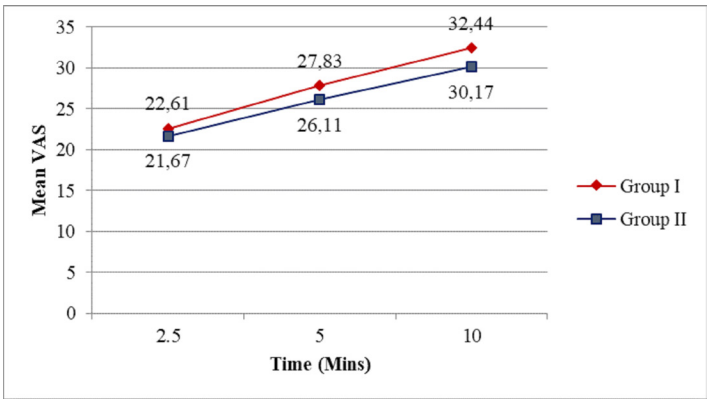

Figure 1. Mean VAS scores and time-dependent changes in Group 1 and 2

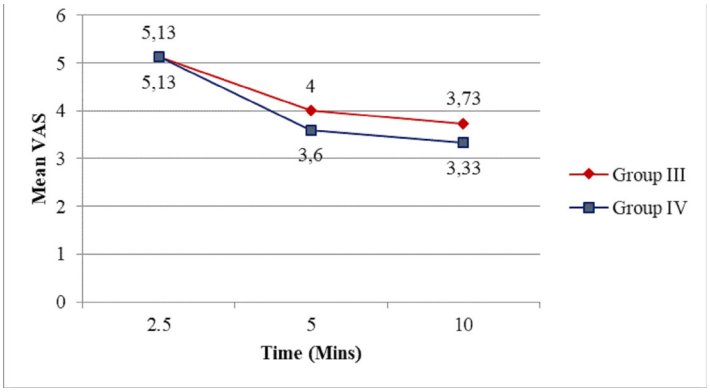

Figure 2. Mean VAS scores and time-dependent changes in Group 3 and 4

Table 1. Mean VAS scores and time-dependent changes in Group 1 and 2

		Group I	Group II	
VAS		mean±SD	mean±SD	px
Time (mins)	2.5	22.61±2.77	21.67±2.17	0.263
	5	27.83±2.68	26.11±2.05	0.058
	10	32.44±2.09	30.17±1.76	**0.001**
		py<0.001	**py<0.001**	

Table 1. Mean VAS scores and time-dependent changes in Group 3 and 4

		Group III	Group IV	
VAS		Median(min-max)	Medi-an(min-max)	px
Time (mins)	2.5	5.00(3.00-7.00)	5.00(4.00-7.00)	0.965
	5	4.00(3.00-6.00)	4.00(3.00-4.00)	0.312
	10	3.00(3.00-6.00)	3.00(3.00-4.00)	0.284
		py<0.001	**py<0.001**	

Discussion

In a study by Sharma and Rashmi, tourniquet use was evaluated and the importance of tourniquet pain was reported [5].

Forearm and upper-arm tourniquets were investigated in a 100-patient case series by Cousins and colleagues. They did not find any statistically significant differences between groups in terms of pain, physiological response, tourniquet duration, bloodless surgical area, and operation time [8]. However, Mauray et al. reported that forearm tourniquet is more tolerable for patients while the duration of tourniquet is longer [9]. A study by Glyn et al. also declares the forearm tourniquet to be more tolerable in carpal tunnel release surgery performed with local anesthesia [10].

Odinsson and Finsen reported several findings in their study; both forearm and upper-arm tourniquets were shown to maintain perfect bloodless surgical area, forearm tourniquet duration was longer and caused flexion in the fingers, there was no pain difference between tourniquet methods during the operation, and there were significant increases in pain, blood pressure and heart rate with >20 min tourniquet duration [11].

Nagpal et al. reported that patients were discomforted by tourniquets and there were no long-term differences in outcome with or without tourniquets [12].

Tzarnas and colleagues used local anesthesia and epinephrine in carpal tunnel release surgery and obtained a clean surgical area. They indicated that tourniquets were not needed in CTS surgery [3].

Four different groups were evaluated in our study. A bloodless surgical area was obtained in Groups 1 and 2. In spite of this advantage, their VAS scores were higher when compared to Groups 3 and 4. In Group 2 (patients with forearm tourniquet), problems with surgical position and finger flexion were encountered. The results of patients in Group 3 are satisfactory because they had low VAS scores and clean surgical area. Odinsson and Finsen have reported pain, heart rate and blood pressure problems with a tourniquet duration longer than 20 minutes. In our study, none of the operations exceeded 12 minutes. We did not observe significant heart rate or blood pressure increase in any of our cases. However, we found that the 10-minute VAS score of Group 1 was significantly higher than that of Group 2 ($p=0.001$).

Conclusion

All four methods used have inherent advantages and disadvantages. Decision for approach must be made on a case-by-case basis. We believe that the local anesthetic + epinephrine without tourniquet (Group 4) method is advantageous compared to the other methods because VAS score is low, positioning is easier, and a bloodless surgical area is ensured.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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Informed consent was obtained from all individual participants included in the study.

References

1. Kerwin G, Williams CS, Seiler JG 3rd. The pathophysiology of carpal tunnel syndrome. Hand Clin. 1996;12(2):243–51.
2. Koris M, Gelberman RH, Duncan K, Boublick M, Smith B. Carpal tunnel syndrome. Evaluation of a quantitative provocational diagnostic test. Clin Orthop Relat Res. 1990 ;251:157-61.
3. Tzarnas CD Carpal tunnel release without a tourniquet. J Hand Surg Am. 1993 ;18(6):1041-3.
4. Mense S, Gerwin RD. Muscle pain: understanding the mechanisms. Springer Verlag, Berlin-Heidelberg. 2010:77–8.
5. Jai Prakash Sharma, Rashmi Salhotra. Tourniquets in orthopedic surgery. Indian J Orthop. 2012;46(4): 377–83.
6. Micheal K. Urban. Anaesthesia for orthopaedic surgery. In: Miller RD, Miller's Anesthesia 7th edition. Churcill Livingstone Publishers, Philadelphia, 2010; 2252.
7. Kutty S, McElwain JP. Padding under tourniquets in tourniquet controlled surgery: Bruner's ten rules revisited. Injury. 2002;33:75.
8. Cousins GR, Gill SL, Tinning CG, Johnson SM, Rickhuss PKJ. Arm versus forearm tourniquet for carpal tunnel decompression - Which is better? A randomized controlled trial. Hand Surg Eur. 2015;40(9):961-5.
9. Maury AC, Roy WS. A prospective, randomized, controlled trial of forearm versus upper arm tourniquet tolerance. J Hand Surg (Br). 2002;27(4):359–60.
10. Glynn A, Strunk S, Reidy D, Hynes DE. Carpal tunnel release using local anaesthetic and a forearm tourniquet. Ir Med J. 2005;98(5):144-5.
11. Odinsson A, Finsen V. The position of the tourniquet on the upper limb. J Bone Joint Surg Br. 2002;84(2):202-4.
12. Kamal Nagpal, Mohammed Gossiel, Hari Kumar. The impact of tourniquet on patient satisfaction in Carpal tunnel decompression. CEJMed. 2007;2(2):222-6.