Clinical Experience in Forearm Tourniquet Use

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Objective: *To assess the efficacy and complications of forearm tourniquet application in minor hand and wrist surgeries those use local anesthesia*
Material and Method: *A series of ninety-three patients underwent various kinds of hand and wrist surgery using forearm tourniquet performed by senior author (SN) at Thammasat University hospital in the last 5 years was collected. The tourniquet was applied at proximal forearm with 250 mm Hg pressure. The surgical tourniquet time tolerated by the patients, postoperative complications, and effectiveness for the surgeon to perform the surgery were collected and analyzed.*
Results: *The forearm tourniquet provided bloodless field in all operations. All patients could tolerate forearm tourniquet up to 80 minutes (average 27 minutes). None of the patients had complications related to tourniquet uses after surgery.*
Conclusion: *Using forearm tourniquet in minor hand and wrist surgery is effective, helpful, and safe.*

Keywords: *Forearm tourniquet, Hand and wrist surgery*

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In the present country, there are high incidences of diseases and accidents of hand and wrist. Many cases have to be treated by operative means. Using the pneumatic tourniquet to provide a bloodless field has become routine for most surgical procedures on the hand and wrist. It allows the surgeon to see the minute structures clearly[1-4]. From the past, traditionally, an upper arm tourniquet had been used in upper extremity surgeries, as it is thought that tourniquet is most safely applied to the area which is well padded with muscles, however current studies have shown that the forearm tourniquet may have been used effectively in many kinds of hand and wrist operations[5-8]. Some authors stated that the patient could tolerate the forearm tourniquet more than the arm tourniquet; and there were no complications in using the forearm tourniquet[9-12].

The objective of the present study was to assess the efficacy and complications of forearm tourniquet in minor hand and wrist surgeries that use local anesthesia in the authors hospital.

Materials and Method

All patients who underwent the hand and wrist operations in Thammasat University Hospital between 2003 and 2006 were included in the present study. The patients were excluded from the study if regional or general anesthesia was used (Monitored Anesthesia Care was acceptable), the forearm tourniquet location might have interfered with the surgical procedure, or the patient had vascular problems precluding the use of a tourniquet. The authors' senior surgeon (SN) performed a variety of hand and wrist procedures in 96 consecutive arms (93 patients). The forearm tourniquet was applied similarly in all cases. Four-inch webril was wrapped circumferentially around to the proximal forearm and a 4-inch wide padded pneumatic tourniquet was then applied approximately 5 centimeters below the medial epicondyle of distal humerus (Fig. 1). All patients had their hands and forearms exsanquinated with an Esmarch bandage before tourniquet inflation. The authors' routinely inflated the tourniquet to a pressure of 250 mmHg. The duration of tourniquet inflation along with the absence or presence of breakthrough bleeding were recorded by the nurse. The sensory and motor tests were done by the surgeon (SN) in the recovery room and at the time patients had their sutures removed (10-14 days).

Results

All patients were divided into 5 groups of diseases presented in Fig. 2.

Tourniquet times were 27 minutes on average (range, 1-80). No breakthrough bleeding disrupted the

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Fig. 1 The 4 inch wide pad of tourniquet cuff was applied to proximal forearm on the endoscopic carpal tunnel release

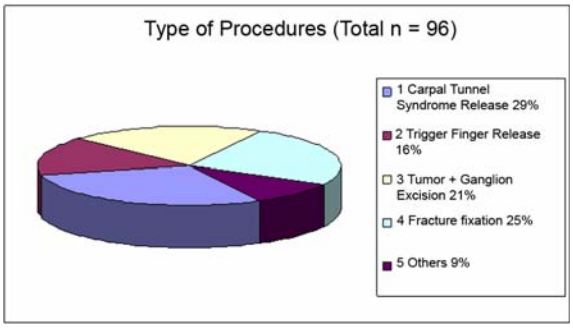

Fig. 2 Pie graph shows variety of operations

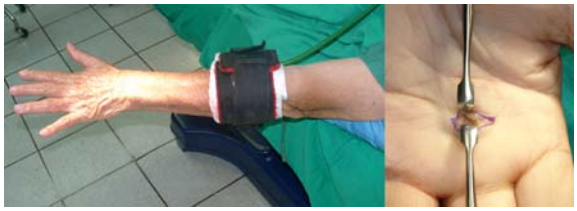

Fig. 3 The forearm tourniquet was applied to the patient whom underwent trigger finger release. After inflating the tourniquet 250 mmHg, there was no bleeding from the wound

procedures. All patients tolerated the tourniquet well; and none asked for deflation of the tourniquet before the operations were finished. Neither neurological deficit nor other complications was found at the perioperative period and the follow-up visit. Demographic data and all results were shown in Table 1.

Table 1. Demographic data and results of the present study

Demographic data & Results	Number
Male (Procedures)	33
Female (Procedures)	63
Age average (years)	41.3 (4-82)
Total number of procedures	96
Average tourniquet time (minutes)	27 (1-80)
Number of break-through bleeding during surgery	0
Number of complications after surgery	0

Discussion

The tourniquet was successful in providing bloodless operative field[1,2] and was specially modified for use in various kinds of limb surgery[3,4].

The previous literature suggested that tourniquets below the elbow were unsafe[13] and could not maintain adequate exsanguinations as blood would leak through uncompressed interosseous arteries in the "valley" between the radius and ulna. Odinsson et al[14] also suggested using the upper arm tourniquet to perform hand and wrist surgeries due to the difficulties of using the forearm tourniquet.

However, these opinions were opposed by later studies. The carpal tunnel release was performed successfully by using the forearm tourniquet[7,8]. Edwards et al[5] demonstrated that many hand procedures could be performed safely using the forearm tourniquet and the pain scores were not different when compared with the upper arm tourniquet. Khuri et al[6] also successfully used the forearm tourniquet in many kinds of wrist and hand surgeries. Hutchinson et al[9] noted that the forearm tourniquet was tolerated for longer period when compared with the conventional arm tourniquet. No significant correlations were found between tourniquet tolerance and age, height or weight of the volunteers. Several authors[10-12] also reported better tolerance of the forearm tourniquet use.

In the present series, the senior author (SN) performed the operations on actual patients and used local anesthesia in all patients with some receiving Monitored Anesthesia Care. As the results indicate, patients could tolerate the ischemia up to 80 minutes (average 29 minutes) which was enough to perform many kinds of operation such as tumor mass removal or open reduction and internal fixation of hand fractures. Sometimes these procedures might take extended time especially in inexperienced surgeons, so the upper arm tourniquet with local anesthesia was not suitable for use in these cases.

The 250 mmHg pressure tourniquet was effective to perform the surgical procedures without inconvenience and no breakthrough bleeding was observed (Fig. 2). Klenerman et al reported that there is little effect on blood acidity with spontaneous recovery after deflation of the tourniquet in Rhesus monkeys[15]. Complications such as limb swelling[16], transient compartment syndrome[17], transient paralysis[18-20] and subclinical temporary denervation of muscles after performing carpal tunnel release[21] were reported in the literatures of the tourniquet use, but none in the present series. Odinsson et al surveyed the tourniquet-use information in Norway and reported about 0.032% incidence of over-all complications including skin necrosis, deep venous thrombosis and nerve complications[22].

Conclusion

The forearm tourniquet is a safe and effective device for hand and wrist surgery and patients tolerate it very well. The authors recommend using the forearm tourniquet in minor hand and wrist surgery with local anesthesia.

Potential conflicts of interest

None.

References

1. Ogufere WE, Giddins GE, Thom JS. Upper arm tourniquet pain in local anaesthetic surgery. J Hand Surg Br 1995; 20: 413-4.
2. Lundborg G, Rydevik B. The bloodless field in surgery on the upper extremities-theoretical and practical aspects. Lakartidningen 1982; 79: 4035-40.
3. Dickson CS, Gregory RT, Parent FN, Wheeler JR, Snyder SO, Gayle RG, et al. A new technique for hemodialysis access surgery: use of the pneumatic tourniquet. Ann Vasc Surg 1996; 10: 373-7.
4. Smoot EC 3rd. Modified use of extremity tourniquets for burn wound debridement. J Burn Care Rehabil 1996; 17: 334-7.
5. Edwards SA, Harper GD, Giddins GE. Efficacy of forearm versus upper arm tourniquet for local anaesthetic surgery of the hand. J Hand Surg Br 2000; 25: 573-4.
6. Khuri S, Uhl RL, Martino J, Whipple R. Clinical application of the forearm tourniquet. J Hand Surg Am 1994; 19: 861-3.
7. Glynn A, Strunk S, Reidy D, Hynes DE. Carpal tunnel release using local anaesthetic and a forearm tourniquet. Ir Med J 2005; 98: 144-5.
8. Baguneid MS, Sochart DH, Dunlop D, Kenny NW. Carpal tunnel decompression under local anaesthetic and tourniquet control. J Hand Surg Br 1997; 22: 322-4.
9. Hutchinson DT, McClinton MA. Upper extremity tourniquet tolerance. J Hand Surg Am 1993; 18: 206-10.
10. Yousif NJ, Grunert BK, Forte RA, Matloub HS, Sanger JR. A comparison of upper arm and forearm tourniquet tolerance. J Hand Surg Br 1993; 18: 639-41.
11. Ng ES, Ting JR, Foo SL, Akram SA, Fadzlina AA, Alywiah JS, et al. The comparison of discomfort level between upper arm and forearm tourniquet. Med J Malaysia 2006; 61 (Suppl B): 23-6.
12. Maury AC, Roy WS. A prospective, randomized, controlled trial of forearm versus upper arm tourniquet tolerance. J Hand Surg Br 2002; 27: 359-60.
13. Sanders R. The tourniquet. Instrument or weapon? Hand 1973; 5: 119-23.
14. Odinsson A, Finsen V. The position of the tourniquet on the upper limb. J Bone Joint Surg Br 2002; 84: 202-4.
15. Klenerman L, Biswas M, Hulands GH, Rhodes AM. Systemic and local effects of the application of a tourniquet. J Bone Joint Surg Br 1980; 62: 385-8.
16. Silver R, de la Garza J, Rang M, Koreska J. Limb swelling after release of a tourniquet. Clin Orthop Relat Res 1986; (206): 86-9.
17. O'Neil D, Sheppard JE. Transient compartment syndrome of the forearm resulting from venous congestion from a tourniquet. J Hand Surg Am 1989; 14: 894-6.
18. Savvidis E, Parsch K. Prolonged transitory paralysis after pneumatic tourniquet use on the upper arm. Unfallchirurg 1999; 102: 141-4.
19. Landi A, Saracino A, Pinelli M, Caserta G, Facchini MC. Tourniquet paralysis in microsurgery. Ann Acad Med Singapore 1995; 24 (4 Suppl): 89-93.
20. Hidou M, Huraux C, Viry-Babel F, Laxenaire MC. Pneumatic tourniquet paralysis. A differential diagnosis after loco-regional anesthesia of the upper limb. J Chir (Paris) 1992; 129: 213-4.
21. Nitz AJ, Dobner JJ. Upper extremity tourniquet effects in carpal tunnel release. J Hand Surg Am 1989; 14: 499-504.
22. Odinsson A, Finsen V. Tourniquet use and its complications in Norway. J Bone Joint Surg Br 2006; 88: 1090-2.

ประสบการณ์การผ่าตัดเล็กทางมือโดยใช้ forearm tourniquet

รัฐฤกษ์ อรุณากูร, สัญญาณ เนียมปุก

วัตถุประสงค์: *เพื่อศึกษาถึงประสิทธิผลและภาวะแทรกซ้อนของการใช้ forearm tourniquet ในการผ่าตัดเล็กทางมือ*

วัสดุและวิธีการ: *คณะผู้นิพนธ์ได้เก็บรวบรวมข้อมูลประสบการณ์การผ่าตัดเล็กบริเวณมือและข้อมือโดยใช้ forearm tourniquet ของหนึ่งในคณะผู้นิพนธ์ (สัญญาณ เนียมปุก) ในช่วงระยะเวลา 5 ปี ทั้งนี้มีจำนวนผู้ป่วยที่เข้ารับการผ่าตัดทั้งสิ้น 93 ราย ได้มีการเก็บรวบรวมข้อมูลและรายงานผลในแง่ของระยะเวลาที่ผู้เข้ารับการผ่าตัดสามารถทนความเจ็บปวดจากภาวะการขาดเลือดในขณะผ่าตัด, ประสิทธิผล, และผลแทรกซ้อนหลังการผ่าตัดในการใช้ forearm tourniquet อัดลมจนได้ระดับความดันที่ 250 มิลลิเมตรปรอท*

ผลการศึกษา: *ไม่มีเลือดไหลออกมารบกวนการผ่าตัดในผู้ป่วยทุกราย โดยเฉลี่ยผู้ป่วยสามารถทนความปวดจากการขาดเลือดได้นานประมาณ 27 นาที (นานที่สุด 80 นาที) และหลังผ่าตัดไม่มีผู้ป่วยรายใดเกิดภาวะแทรกซ้อนจากการใช้ forearm tourniquet*

สรุป: *จากข้อมูลที่ได้สรุปผลว่าการใช้ forearm tourniquet เพื่อช่วยลดปริมาณเลือดออกรบกวนการผ่าตัดมีประสิทธิภาพสามารถใช้ช่วยในการผ่าตัดเล็กบริเวณมือและข้อมือได้ผลเป็นอย่างดี*