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Measurement of ankle cuff discomfort in unsedated patients undergoing day case foot surgery

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Twelve patients undergoing foot surgery were randomized to receive a common peroneal block prior to surgery and were compared with a control group receiving a standard ankle block used in the department for foot surgery. The common peroneal block provided no significant benefit in achieving greater tourniquet comfort. Patients exposed to ankle cuffs are more likely to experience discomfort when applied for periods greater than 45 min at pressures of 250 mmHg and above. Discomfort appeared more commonly related to the posterior tibial area.

Key words: Foot surgery, tourniquet, regional anaesthesia, peroneal nerve infiltrations, podiatry

Introduction

Adequate haemostasis using automatic, regulated pneumatic tourniquet operated cuffs during foot surgery has been well documented[8]. The use of a cuff at the ankle level, as opposed to the thigh, is commonly used in unsedated patients undergoing regional anaesthesia; primarily because less discomfort is experienced. The problem with thigh placement may be associated with higher cuff pressures needed to control haemostasis. Lichtenfeld has disputed previous views suggested by Klenerman concerning potential nerve damage from compression[8]. Trauma at the site of the ankle, where there is less muscle bulk and fat to cushion the bone and nerves against pneumatic compression, is thought to make the technique less safe.

An Esmarch tourniquet can be used to exsanguinate the limb effectively before inflating the cuff. On its own, the Esmarch tourniquet has been found to be perfectly safe and is used as an alternative to the pneumatic cuff. Pressures of 250 mmHg have been measured and can be safely used for up to 2 h[7]. Pressures can be increased however by placing more wraps of the elastic material around the ankle. While the pressure created around the ankle was shown to have no side effects, comfort was not measured or discussed.

Foot surgery can be performed using four main systems of anaesthesia: general, central (spinal or epidural), intravenous (Bier block) and peripheral regional blocks. Regional (placed at the knee, ankle or foot level) anaesthesia appears to have no recorded systemic problems compared to other methods, save injudicious intravascular infiltration. Such anaesthesia is effected by infiltrating small volumes of anaesthetic around specific nerves. The technique is suitable for cases often regarded as a poor anaesthetic risk. The risk of intravascular infusion is unlikely in skilled hands and such procedures can be performed without an attendant anaesthetist. The comfort for the conscious patient is often affected by cuff anxiety. While a general anaesthetic can be offered should discomfort become intolerable[4,8], any extension of maximum cuff times would be precluded by the anaesthetic model as custom and practice prefer optimum cuff times of around 90 min when using any form of anaesthetic. Replacement of cuffs may be carried out after a period of rest, thus extending haemostasis where necessary. In unsedated patients, the author (DT) has found comfort seems to last for a much shorter period on reapplication.

Intravenous anaesthesia, as with general and spinal methods, should only be performed by an anaesthetist. The use of double cuff chambers however can eradicate cuff discomfort around the ankle and are therefore suitable for conscious patients[9]. Comfort is achieved by allowing intravenous anaesthesia to perfuse under the distal chamber before deflating the proximal chamber. The greatest risks from Bier blocks arise from intravascular damage and systemic effects of a large bolus of anaesthetic suddenly entering the central vascular system.

Ankle cuffs are set at 100–150 mmHg above systolic pressures. Binns and Prendergast[1] found that patients became restless and complained of pain when pressures

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above 210 mmHg were applied around the ankle, the calf or thigh for longer than 30 min. In order to ameliorate cuff discomfort, a new cuff was devised which incorporated an air bag to compress the posterior tibial vessels, allowing pressures of 250 mmHg following exsanguination. This cuff design was tolerated for up to 40 min. While the cuff designed by Binns and Prendergast looks encouraging, little discussion has considered some of the additional problems met with ankle cuffs. Problems include ankle oedema and the need to manage sudden raised systolic pressures and the effects of vascular leakage. Infiltration of anaesthesia around the superficial peroneal nerve around the ankle was thought to supplement cuff comfort[2].

Gurmarnik and Hurwitz[6] observed that a combined saphenous and common peroneal block, performed above the ankle, could ameliorate cuff discomfort. Operation time was extended up to 98 (±7) min in their study of 42 infiltrations. They observed that using traditional regional blocks, ankle tourniquets could be tolerated up to 47 min.

Lichtenfelt[8] identified two patients who, at 45 and 70 min respectively, reported mild pain. One patient, in his study of 76 patients, required a general anaesthetic. Another patient had venous oozing which was overcome by tourniquet release.

Cuff pain is characterized by patients becoming fidgety, raised blood pressure, obvious anxiety and even crying. While these signs and symptoms are highly undesirable, the last part of a procedure can be critical to maintaining good haemostasis. Any technique that can improve comfort, particularly after the empirical band of 45 min is worth investigating.

Most day case foot surgery lasts between 10–90 min with 67% of operations falling into the band 16–30 min[10]. The anaesthetic technique was performed as a regional ankle block or metatarsal block using 1 or 2% prilocaine.

Methods and materials

This paper concerns data from a clinical audit to measure the effectiveness of a common peroneal block to deal with cuff discomfort during surgery. The use of a visual analogue scale (VAS) was used to record discomfort during the course of surgery with a cuff applied superior to the malleoli. Measurements were taken as a line of continuum, patients should not be able to see the scales, marked as no pain to worst pain possible. The advantage of VASs is that they can provide interval measurement, do not require descriptive terms and provide many points to select from[7].

Patients

Patients were randomized for either a common peroneal block (CPB) and placed in group A, or in a control group B. Patients were randomly chosen by their date of birth and males and females were randomly accepted into the project. Those with odd birth years were entered into group A and even years, Group B. Both groups received the standard inferior ankle blocks, suited to the intended surgery (Table 3). Anaesthesia at the inferior ankle level followed either a tibial block or metatarsal ring block with plain anaesthesia.

Measurement

Units taken from the VAS were measured with a 15 cm ruler. Pain was recorded for the time of onset, intolerable discomfort time (IDT) and the maximum discomfort level. The initial level of discomfort was recorded and then the final discomfort level, maximum discomfort level (MDL). The difference between these two points was recorded as the difference in discomfort level (DDL). The sheet was scored with a fine pen. Time was recorded in minutes, CPB effect noted (worked or failed); the IDT was recorded separately and the maximum cuff pressure was recorded. Patients' weight and height were noted together with age.

The term 'discomfort' was adopted as pain is a relative expression. Maximum discomfort was regarded as a point where the patient advised that they were experiencing intolerable discomfort.

Common peroneal block

CPB consisted of 1% plain prilocaine injected inferior and posterior to the head of the fibula at the neck which was usually palpable. The block was given up to 30 min before surgery and usually showed an onset within 5–25 min. A Braun nerve stimulator, Stimuplex, was available where anaesthesia proved to be difficult. The quantity of local anaesthetic consisted of an initial bolus of 5 ml, if this failed a further 2–5 ml was administered.

Surgery

All operative procedures were undertaken on the forefoot (Table 3). Forty-three patient results were collected initially, 28 patients were accepted and placed into group A and group B (Table 1). All patients in the first two groups were unsedated. An effective CPB was considered when either the patient showed sensory loss over the cuff area at the end of surgery or when foot drop was elicited before surgery. Those patients who had a CPB which failed were placed into a further group C and group D, where results were affected by outside factors such as premedication or preoperative oral analgesics.

Ankle cuff

The tourniquet was placed 0.5 cm above the medial malleolus and padded with orthopaedic cast wool (Velband, Johnson & Johnson); the padding extended beyond the cuff for 0.5 cm. Cuff sizes varied according to the system available in one of five theatres used. The same protocol for precuff exsanguination using an Esmarch bandage was adhered to by each of the three

Table 1. Patient data (n = 43)

Sex	*Age*	*MDL*	*DDL*	*Time*	*Pressure*	*wt*	*ht*	*IDT*
Group A – subjects provided with a common peroneal block which was deemed successful								
F	35	16	10	48	220	48.8	1.50	–*
M	51	07	10	41	300	89.1	1.78	–
F	19	77	76	70	205	72.0	–	–
F	55	01	00	–	250	74.8	1.58	–
F	53	64	52	52	243	97.5	1.66	–
F	52	25	22	60	250	74.8	1.66	53
F	–	03	00	35	210	55.3	1.53	–
F	67	04	00	22	260	–	–	–
F	77	89	84	71	260	55.9	1.55	56
F	25	19	00	70	250	–	–	–
F	21	02	00	14	210	52.9	1.59	–
F	52	25	22	60	250	–	–	–
Group B – subjects not exposed to common peroneal block								
F	26	100	102	83	212	70.0	1.68	68
F	40	21	00	49	240	58.5	1.60	–
F	68	02	00	73	290	62.0	1.78	–
M	56	07	03	52	250	78.0	1.75	–
F	50	84	82	68	250	86.5	–	–
F	54	55	00	85	226	61.8	1.53	–
F	36	05	05	44	240	75.1	1.63	–
F	52	04	02	55	250	65.0	1.38	–
F	22	04	02	68	213	–	–	–
F	72	10	00	16	264	–	–	–
F	72	50	50	20	260	54.0	1.58	–
F	40	10	02	41	–	104.0	1.69	–
F	30	51	51	47	240	58.5	1.65	–
F	58	69	22	74	260	61.4	1.50	53
M	56	51	24	83	240	–	–	–
F	58	46	00	44	230	71.5	1.65	–
Group C – subjects who failed to respond to CPB from group A								
F	32	82	80	88	238	69.6	1.58	78
F	78	08	05	35	270	57.6	1.70	–
F	67	07	03	31	250	68.3	1.55	–
F	71	58	54	22	260	62.4	1.55	–
F	71	03	00	49	270	74.8	1.68	–
F	35	75	73	72	250	65.0	1.71	60
F	59	12	08	69	320	71.5	1.64	–
F	69	08	00	107	280	58.5	1.55	–
F	29	28	26	80	230	52.0	1.58	–
Group D – subjects excluded from study (see text)								
M	59	28	23	93	300	68.3	1.56	–
F	42	41	37	27	220	46.8	1.60	–
F	54	16	09	35	240	–	–	35
F	72	10	00	40	260	59.4	1.55	–
F	68	87	55	71	310	73.0	1.56	63
M	69	10	07	28	250	–	–	–

MDL, Maximum discomfort level; DDL, difference in discomfort level (before and at end, before cuff release); IDT, intolerable discomfort level. Groups C/D were included for complete data. *Data not available.

surgeons. The cuff was inflated and maintained at 100 mmHg above systolic pressure, using either a Thackeray, Stille type CO_2 (two independent cuffs) or an air Stille system (single independent cuff). Only single cuffs were used. The patients were monitored, where possible with a Critikon, Dinamap 845XT vital signs monitor, set for 2–4 cycles per hour.

Exclusions in group D

Two patients were excluded because of need for sedation; oral diazepam in one case and intramuscular midazolam in the other. Another patient took nearly one week's worth of non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol with 30 mg codeine phosphate × 2 without direction prior to surgery, and was excluded.

Results

Patient data was recorded and is shown in Tables 1, 2 and 3.

Difference between groups A and B

Maximum discomfort levels (MDL) and difference in discomfort levels were compared using a Mann-Whitney U test ($P > 0.05$); no significant difference was determined.

Correlation

Total operative cuff time against MDL ($R = -0.13$). Cuff pressure against MDL ($R = 0.41$), both showing no association as seen by the scattergram, representing all the groups (see Figure 1). Height and weight as well as age showed no significant correlation with discomfort levels.

Pain analysis

Intolerable discomfort time (IDT) showed a range between 35–78 min, MDL ranging between 16–100 (mean = 67.9, SD = 30.8). Eight patients (18.6%) recorded intolerable discomfort (95% CI = 7.0–30.2). Absence of pain was further analysed using a 2 × 2 contingency table (χ^2 with Yates correction $\chi^2 = 0.0047$, df = 1). The CPB produced no significant reduction in discomfort.

Difference between group times

Data for groups A–C were separated into patients who were exposed for 45 min ($n = 12$) and those >45 min ($n = 23$); significance was shown, $P < 0.05$ using a Mann-Whitney two tail test.

Discussion

Only eight (18%) female patients (88.4% of the study) recorded intolerable discomfort on their record sheets.

Table 2. Data for 43 patients, groups A–D

	Pressures (mmHg)	*Age (yr)*	*Time (min)*	*MDL (mm)*
Range	205–320	19–78	14–107	1–100
Median	250	54	52	17.5
Missing data	1	1	1	0

Table 3. Forefoot procedures

Osteotomy first ray	14
First MTP implant	3
Keller excisional Arthroplasty	4
Lesser metatarsal	1
Arthrodesis hallux IPJ	1
Lesser toe IPJ	5
Neurectomy	3
Excision tissue	3
Combinational osteotomy	8*
Implant/screw removal	1
Total	43

*Combinational procedures include first ray and at least one other procedure.

One patient showed psychological distress; in her case anxiety appeared to occur in similar environments to the day surgery unit, such as seeing the dentist.

One patient, aged 54, having received midazolam (IM), stated a maximum level of discomfort of 16 on the VAS scale at 35 min, at a blood pressure of 240 mmHg and indicated an intolerable level of discomfort. The majority of patients were able to remain comfortable for more than 16 min. The result recorded above seemed atypical of that expected and was possibly associated with a misunderstanding in recording. Age and blood pressure were not found to correlate with onset of cuff discomfort.

Discomfort from the cuff was thought to stem from anterior shin compression in our own patients. Analgesia in the form of superior anaesthesia (given above the ankle) should ideally ameliorate such discomfort around the site of the cuff. During the course of the study, however, it was soon realized that the site of greatest discomfort lay at the posterior calf, not the anterior aspect of the tibia as previously thought; an area not supplied by the common peroneal or indeed the saphenous nerve.

The clear failure of the CPB technique in achieving 'foot drop' or dorsal anaesthesia on occasions was related to differences in operator technique and the natural difficulty in locating a nerve, reputed to be easy to locate around the head of the fibula.

The use of the VAS system for pain measurement may not be sensitive enough as an 'outcome measure'. Despite the use of the word 'discomfort', instead of 'pain', it was felt that some patients, perhaps more often the older group, had greater difficulty in following the

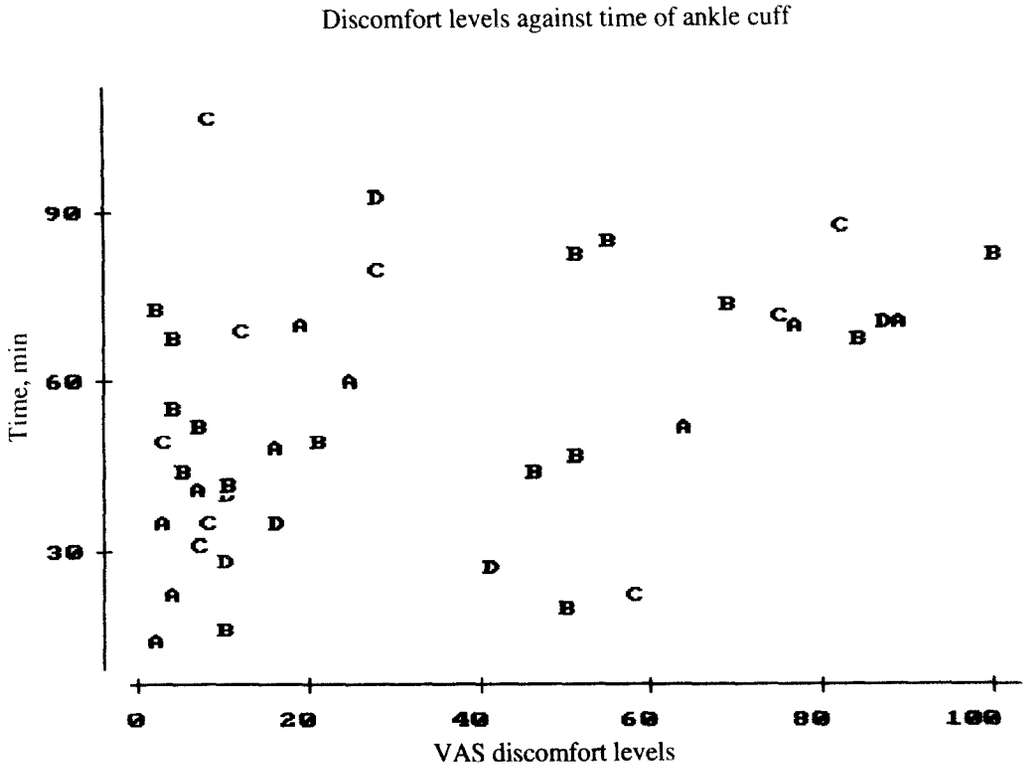

Figure 1 A scattergram was produced showing discomfort levels 0–100 against time. Each group A–D, identified separately in each table, was shown. No correlation was shown on line of best fit.

instructions. At the time of recording data, patients had to be carefully checked not to record levels more than twice. The scale used to measure discomfort was more complex than necessary, having been traced from a plastic VAS measurement tool; this scale should be simplified without double continuous ended lines.

Some cuffs had two and a half wraps as opposed to single wraps; perhaps this should have been recorded except that there appeared to be little association with pressure and pain levels.

Conclusion

Pain will increase after 45 min using an ankle tourniquet ($P < 0.05$). This has implications for planning long duration foot surgery under local anaesthetic regional blocks. As a result of this study, where complex techniques and multiple digital surgery on one foot are required, other factors such as effective postoperative pain control and infection is felt to be better controlled by staging procedures within the time according to the surgeon's skill and capability.

The use of a common peroneal block may well assist anterior shin discomfort but cannot affect the posterior leg. There was no significant difference between the CPB, group A to suggest that the use of the block should be used primarily to ameliorate cuff discomfort. The authors question the accuracy behind the empirical findings associated with the Gurmarnik study[8]. The CPB showed no undesirable postoperative effects when used in the manner described for 13 patients; other authors have warned of a risk from postanaesthetic neuritis[5].

The presumption that a CPB is easy to administer cannot be supported as nine (42.9%) infiltrations failed and a nerve stimulator did not retrieve all such failures. Inexperienced practitioners, unfamiliar with the anatomy may easily have similar results.

Particular scrutiny is required when using the VAS for assessment. In the absence of a quick, cheap and simple system, normalizing patients' responses will remain a problem for clinical research of this nature. Sample size is another problem affecting reliability of results. In this project, sample size was less than desired. Nonetheless, the experience of processing surgical activity is essential for audit and improving quality when delivering this type of care.

This research was undertaken at Manor Hospital, Walsall and Northampton (Nene College) at Northampton General Hospital day surgery units in 1994.

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