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Continuous Peripheral Nerve Block for Ambulatory Surgery

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Background and Objectives: Continuous peripheral nerve block (CPNB) can provide surgical anesthesia, prolonged postoperative analgesia, and acceptable side effects. Despite these advantages, CPNB is not in widespread use. Recently a new CPNB catheter system (Contiplex, B. Braun, Bethlehem, PA) was developed based on an insulated Tuohy needle, which allows for injection of local anesthetic and catheter insertion without disconnection or needle movement. At present, no clinical studies exist describing this system.

Methods: Data were prospectively gathered for 1 year from 228 patients in an ambulatory surgery center. All CPNB were performed using the Contiplex system to provide anesthesia and postoperative analgesia. CPNB were performed using 5 upper and lower extremity techniques. Postsurgery local anesthetic was infused and at 24 hours, a rebolus of local anesthetic was performed. The CPNB catheter was removed and patients were examined for loss of sensation. Patients were then discharged.

Results: Initial peripheral block was successful in 94% of patients. Failed nerve block requiring general anesthesia occurred in 6%. The catheter was patent and functional in 90% of patients at 24 hours, and 8% of patients required more than 10 mg of intravenous morphine by 24 hours postsurgery. In the postanesthesia care unit (PACU), only 4 patients (1.7%) required treatment for nausea. At 24 hours and 7 days postsurgery, no patient reported a dysesthesia.

Conclusions: CPNB using the insulated Tuohy catheter system offered acceptable anesthesia and prolonged pain relief postsurgery. There were few side effects. *Reg Anesth Pain Med 2001;26:209-214.*

Key Words: Continuous peripheral nerve block, Ropivacaine, Ambulatory surgery.

Peripheral nerve blocks are useful in providing surgical anesthesia and postoperative analgesia with minimal side effects. Single injection block techniques, despite their efficacy, provide only finite length of postoperative analgesia. Surgical anesthesia and prolonged postoperative analgesia can be provided by continuous peripheral nerve block (CPNB). Despite the efficacy of CPNB, the lack of available equipment has contributed to insertion difficulties. These difficulties have led to CPNB not being widely used or its use restricted to certain centers where equipment is often assembled from other available devices.[1]

Recently a CPNB catheter delivery system based on an insulated 18-gauge Tuohy epidural needle was developed at our institution[2] (Fig 1). The system utilizes a connector for a nerve stimulator attached to an 18-gauge Tuohy needle. The needle is insulated utilizing a Teflon coating. At the proximal end of the needle is an adapter using a luer-lock head with central diaphragm and side arm connector. The adaptor allows the aspiration of blood, injection of local anesthetic, and passage of a peripheral nerve catheter without changing position of the needle or disconnecting the tubing. The goal of the system is to facilitate the performance of CPNB. Despite anecdotal reports, no data exists on its efficacy. We report a study of 228 consecutive patients who received a CPNB in an ambulatory surgical center using this needle-catheter system.

Methods

The hospital's Institutional Review Board approved the protocol for this study. Using information recorded prospectively in the Ambulatory Surgery Center (ASC) database during a 1-year period,

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Drs. Steele and Greengrass hold the patent on the contiplex system used. The needles used were all supplied at no cost by B. Braun Medical.

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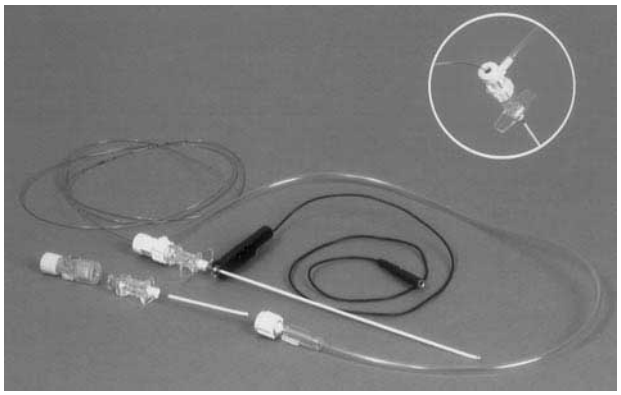

Fig 1. Illustration of CPNB catheter system.

228 patients receiving a CPNB were identified. No patients were excluded for any reason. Copies of all anesthetic records, charts, and ASC databases were obtained to retrospectively tabulate the other information. The ASC database was used to provide information at 24 hours and 7 days postsurgery.

All continuous catheters were performed using a standard insertion procedure. All patients were brought into a preoperative holding area. Supplemental oxygen was administered, and routine monitors were applied. The patients were then sedated using intravenous fentanyl (0 to 3 μgkg^{-1}) and midazolam (10 to 50 μgkg^{-1}), individually titrated. Using a nerve stimulator connected to an insulated Tuohy needle (Contiplex, B. Braun, Bethlehem, PA), peripheral nerve blocks were performed based on the site of planned surgery (Table 1).[3-6] The needle was advanced until an appropriate motor stimulus was elicited with a current of 0.2 to 0.5 mA. The Tuohy needle, attached via tubing to a syringe, was aspirated for blood to preclude unintentional intravascular injection. Then 0.5% ropivacaine with 1:400,000 epinephrine was injected in divided doses. Maintaining the needle in the same position, a 20-gauge standard epidural catheter was advanced 5 to 10 cm past the distal end of the needle. The needle was removed, and the catheter was secured with medical adhesive spray, steristrips, and transparent occlusive dressing. Patients were transferred to the operating room. The magnitude of neural block was documented on the ASC database by trained nurses as: (1) surgical quality; (2) planned combined general anesthetic with peripheral nerve block; (3) reblock; (4) inadequate nerve block requiring local anesthesia supplementation; or (5) failed block requiring general anesthesia. A record was made in the database of all acute block complications: parasthesia, extradural block, subarachnoid block, hematoma, preseizure excitation, seizure, pneumothorax, respiratory arrest, cardiac dysrythmia, or arrest, if they occurred. At the conclusion of surgery, patients were transferred to the postanesthesia care unit (PACU). On entry to the PACU, assessments of pain at rest and dynamic pain (with movement) were made by patients using a verbal analogue score (VAS) (0-10, 0 = no pain, 10 = worst pain imaginable). Postoperative nausea and vomiting (PONV) was also assessed by the patients using a similar scale (0-10, 0 = no PONV, 10 = worst PONV imaginable). The PACU nurse assessed sedation on arrival in the unit using a "Modified Ramsey Score"[7]: (1) Patient anxious, agitated or restless; (2) Patient cooperative, oriented and tranquil; (3) Patient responds to vocal commands only; (4) Patient asleep. Responds to gentle shaking or loud auditory stimulus; (5) Patient asleep. Does not respond to gentle shaking or loud stimulus, but responds to pain; (6) Patient unarousable. Does not respond to noxious stimulus. In addition, respiratory and hemodynamic complications requiring the intervention of a nurse were recorded. All PACU information was recorded with our standardized ASC database. Topically applied cooling therapy was commenced. Prior to discharge from PACU, all catheters were aspirated for blood to

Table 1. Table of Nerve Block Techniques and Local Anesthetic Dosage Used

	Patient Position	Tuohy Needle 18-Gauge Length Used	Motor Movement Sought	Volume of 0.5% Ropivicaine (mL)	Length of Catheter Inserted Beyond Needle Tip (cm)
Interscalene	Supine	5 cm	Deltoid or biceps	35 mL	3-5 cm
Axillary*	Supine, arm abducted 90°	5 cm	Intrinsic muscles in the hand	40 mL	5-7 cm
Lumbar†	Lateral decubitus	15 cm	Quadriceps	30 mL	5-10 cm
Femoral‡	Supine	5 cm	Quadriceps	30 mL	5-10 cm
Sciatic§	Sims position	15 cm	Plantar/dorsiflexion of the foot	20 mL	5-10 cm

* Technique as described by Winnie.[3]
† Technique as described by Winnie et al.[4]
‡ Technique as described by Winnie et al.[5]
§ Technique as described by Labat.[6]

detect accidental placement within a vessel. All catheters were infused with 0.2% ropivacaine at 10 mL/h (20 mg/h). Patients were then transferred to a 24-hour recovery care center (RCC) within the ambulatory unit. Postoperative supplemental analgesic instructions were standardized. All patients were prescribed oral ibuprofen 400 mg every 6 hours unless contraindicated. In addition, intravenous morphine 2 mg every 5 minutes to a total of 10 mg and oral oxycodone 5 mg with acetominophen 325 mg every 6 hours as required were prescribed for breakthrough pain. If additional analgesia was needed, an anesthesiologist was contacted.

Approximately 24 hours after the initial nerve block placement, all patients were interviewed and examined. At this time, a bolus of 20 mL of 0.5% ropivacaine with 1:400,000 epinephrine added was injected through each peripheral nerve catheter. After 15 minutes, all patients were examined for loss of pain sensation, touch, and motor power in the appropriate nerve distribution. Patients were also asked to report any symptoms of local anesthetic toxicity, such as ringing in their ears, numbness, metallic taste in their mouth, a dizzy feeling, or disorientation. Pulse and blood pressure measurements were recorded for 30 minutes following the bolus of ropivacaine. A deviation of 20% from baseline was regarded as significant and recorded. The peripheral nerve block catheter was then removed and examined for integrity and noted in the medical record. The puncture site was inspected and dressed. In addition, at 24 hours after nerve block placement, evaluations were made via interview for the database. Assessments were performed of dynamic pain VAS (score of $\leq$2 of 10 regarded as optimal pain management and score of $\geq$3 of 10 regarded as suboptimal), PONV cumulative over the entire hospitalization, block resolution, opioid requirements, and satisfaction with the anesthetic technique. Patient satisfaction assessments were completed using a 5 point scale (5 = highly satisfied, 4 = somewhat satisfied, 3 = equivocal, 2 = somewhat dissatisfied, 1 = highly dissatisfied). These assessments were repeated during telephone interviews 7 days after surgery.

Results

Between July 1998 and July 1999, 228 patients were entered into the database: 108 male, 120 female, mean age, 50.5 years (SD 18.6, max. 85, min. 1), mean height 169 cm (SD 12.9, max. 203, min. 70), mean weight 82.8 kg (SD 21.7, max. 140, min. 7), and of American Society of Anesthesiologists (ASA) status: I, 41 patients; II, 109 patients; III, 75 patients; and IV, 4 patients. Five different approaches for CPNB were used. There were 143 interscalene, 4 axillary, 35 lumbar plexus, 5 femoral, and 41 sciatic catheters placed. The surgeries performed are detailed in Table 2.

Table 2. Table of Surgical Procedures

	No. of Cases
Interscalene continuous catheters	
Total shoulder arthroplasty	41
Shoulder hemiarthroplasty	12
Open rotator cuff repair	52
Open anterior reconstruction	7
Shoulder arthroscopy (closed procedures)	6
Shoulder arthroscopy (open procedures)	18
Open reduction and internal fixation of fracture	4
Fusion of joint	3
Axillary continuous catheters	
Wrist fusion	1
Open reduction and internal fixation	1
Open elbow capsular release and tendon repair	2
Sympathectomy	1
Femoral continuous catheters	
Knee arthroscopy with ligament repair	3
Knee arthroscopy and tibial tubercle osteotomy	1
Knee arthroscopy, loose body removal and continuous passive motion	1
Lumbar plexus continuous catheters	
Anterior cruciate ligament reconstruction	26
Anterior and posterior ligament reconstruction	1
Knee arthroscopy with manipulation, debridement	5
Open reduction and internal fixation	1
Patelo-femoral ligament repair	2
Sciatic continuous catheters	
Ankle joint replacement	4
Ankle arthrodesis	7
Calcaneal osteotomy	2
Open reduction and internal fixation	6
Joint fusion	13
Amputation	2
Achilles tendon debridement	1

The success and quality of all the blocks is depicted in Table 3. The VAS for dynamic pain following admission in PACU is shown in Fig 2. In the interscalene group, only 6 of 143 patients rated their pain on movement greater than 5/10. All were general anesthetic patients with a failed block. Only 25 of 228 patients (10.9%) received opioids in the PACU. Of these, 2 patients were subsequently reblocked in PACU with complete pain relief and no further narcotic requirements.

PONV was well controlled in PACU. Only 4 patients (1.7%) received treatment for PONV in PACU. There were no respiratory complications observed, and only 2 patients were treated for hemodynamic instability in PACU. These 2 patients underwent total shoulder arthroplasties and were treated for hypotension. This was attributed to hypovolemia and resolved with intravenous fluid. No patients complained of pruritis in the PACU. Only 1 patient suffered from urinary retention in PACU,

Table 3. Description of Block Success and Quality

Type of Continuous Nerve Block	No.	1 % (no.)	2 % (no.)	3 % (no.)	4 % (no.)	5 % (no.)
All blocks	228	81 (185)	8 (18)	4.5 (10)	0.5 (1)	6 (14)
Interscalene	143	78.3 (112)	8.4 (12)	3.5 (5)	0.7 (1)	9.1 (13)
Axillary	4	100 (4)	0	0	0	0
Lumbar plexus	35	85.7 (30)	2.9 (1)	8.6 (3)	0	2.9 (1)
Femoral	5	80 (4)	0	0	0	20 (1)
Sciatic	41	80.5 (33)	12.2 (5)	4.9 (2)	0	2.4 (1)

NOTE. 1, Surgical quality; 2, planned combined general anesthetic with peripheral nerve block; 3, reblock; 4, inadequate nerve block requiring local anesthetic supplementation; 5, failed block requiring general anesthesia.

but did not require catheterization. This occurred in a patient with a sciatic catheter with epidural spread. The epidural spread resolved within 2 hours of the initial sciatic nerve block.

In 206 of 228 (90%) catheters placed, evidence of CPNB was present at 24 hours. Dynamic VAS for pain at 24 hours is shown in Fig 2. In the interscalene group, 22 of 143 (15%) patients reported a pain score of 3 or greater at 24 hours. Ten were failed blocks requiring general anesthesia, 6 were combined techniques, 3 were reblocked patients, and 3 were surgical blocks. The percentage of patients requiring oral or intravenous opioids in the first 24 hours following surgery is shown in Table 4. PONV was well controlled in the first 24 hours. In the interscalene group, 16 patients reported a verbal analogue score of 3 or greater for nausea and vomiting. All of these patients used opioids in the first 24 hours.

Eating habits had returned to normal by 24 hours in 198 of 228 patients. At 24 hours, 19 patients reported pruritis. Patients reported their satisfaction with the anesthetic technique as highly satisfied (n = 199), somewhat satisfied (n = 25), or equivocal (n = 4). No patients reported they were dissatisfied with the technique.

The 7-day telephone follow-up was completed in 63% (n = 142) of all patients. The VAS for dynamic pain is shown in Fig 2. Dynamic pain VAS of 3 or greater were noted in 46% of patients contacted. The percentage of patients requiring oral opioids at 7 days was 56% (Table 4). In the interscalene catheter group, 60% were still consuming oral opioids at 7 days (50% in lumber catheter and 45% in sciatic catheter groups). Medical attention for pain relief following discharge was sought in 6% of patients and a further 6% sought medical attention for the treatment of nausea and vomiting following discharge. No patients reported persistent numbness or dysesthesias in the nerve distribution where the blocks were placed.

Discussion

We believe this case demonstrates the efficacy of this CPNB catheter insertion system. The 94% success rate of achieving initial peripheral block demonstrates that this system can be used effectively to initiate a peripheral nerve block in a wide variety of locations. These data are similar to other studies utilizing a nerve stimulator block technique, where block success rates ranged from 79%[8] to 95%.[9] Determining that 90% of catheters were patent and functional at 24 hours, is encouraging for the use of this system as a method of prolonged postoperative pain relief.

CPNB has been used for over half a century.[10] However, despite efficacy, it has not become widely used. One difficulty is the lack of a simple, consistent method of catheter insertion. This limitation can make placing a CPNB cumbersome and operator-dependent. Singelyn et al[11] illustrated this issue when they demonstrated good results, but reported technical difficulties occurring in 66% of catheters placed using a Seldinger insertion technique. This difficulty was further emphasized by Ganapathy et al[12] who demonstrated radiographically that nearly 40% of femoral nerve catheters in their study were misplaced.

The equipment used in this trial affords the ability to use nerve stimulation, aspirate for blood, inject local anesthetic, and pass the continuous catheter without requiring disconnection and needle tip movement. These advantages may offer a system that is less demanding and more successful than systems that rely on catheters over the needle. Although the success of catheter placement is encouraging, the anesthesiologists performing the technique were experienced with the equipment, and the majority had been utilizing it over the past 5 years during its development. This familiarity may have influenced the perceived difficulty with insertion and the success rate. However, given the overall results in this series of patients, a prospective

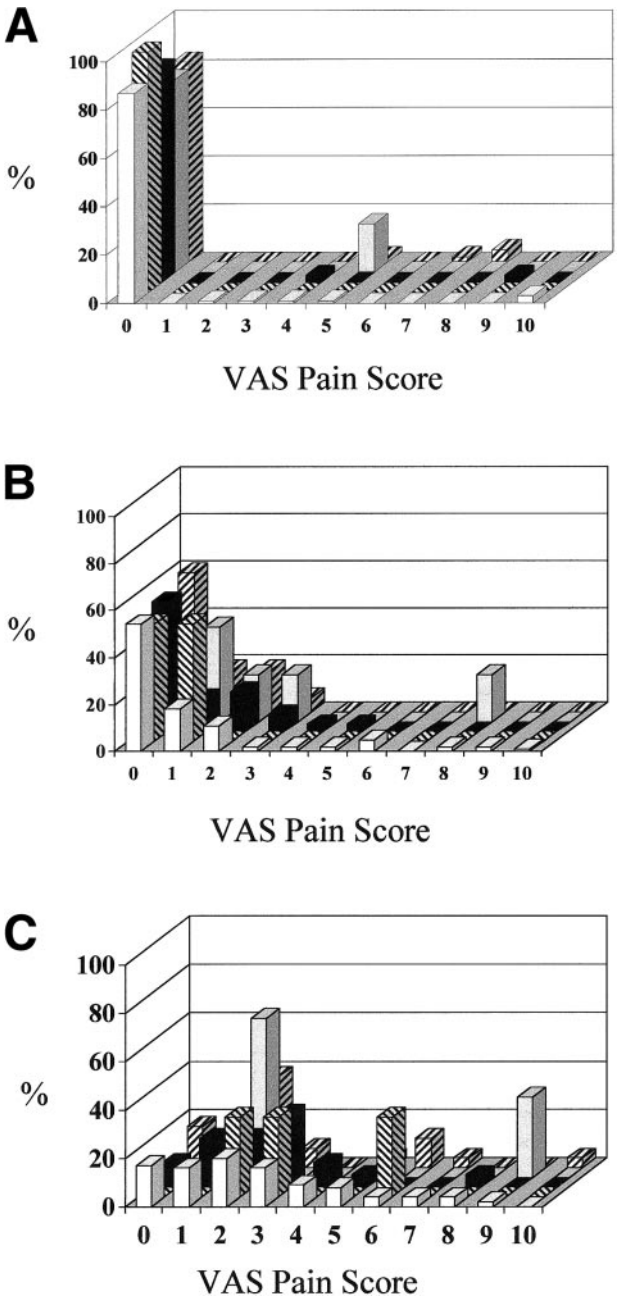

Fig 2. VAS (0 = no pain, 10 = worst pain imaginable) for dynamic pain in all 5 CPNB catheter groups in A: PACU, B: over 24-hour period postsurgery, and C: 7 days postsurgery. □, Interscalene; ▧, Axillary; ■, Lumbar plexus; ▨, Femoral; and ▨, Sciatic.

trial examining new users' learning curves, success and perceived difficulty is needed to further evaluate the equipment. The continuous catheter insertion system was used for 27 different types of surgical procedures that involved 5 different block sites, involving both the upper and lower extremity.

The case of CPNB insertion is also encouraging. The postoperative data demonstrate that combining CPNB with a multimodal pain regimen using nonsteroidal anti-inflammatory drugs, topically applied cooling, and supplemental opioids in an ambulatory surgery setting produced few side effects and low opioid use. The data demonstrate that less than 25% of patients required more than 10 mg of intravenous morphine during the first 24 hours after surgery. Considering this patient population included major operations, such as shoulder and ankle arthroplasty, as well as multiligament knee reconstruction and ankle arthrodesis, emphasizes the importance of pain management. In addition, the magnitude of surgery is demonstrated by the fact that more than 50% of interscalene catheter and lumbar plexus catheter recipients still required oral narcotic for pain control at the 7-day follow-up. These elevated demands for narcotic analgesics demonstrate the impact CPNB anesthesia can have on major surgery, but also highlight the need to extend the duration of analgesia longer than the 24 hours used in this trial. The patients in this study were all hospitalized overnight in our RCC because this was a new clinical area and for investigation purposes. Overnight admission was not required for all patients.

The data in this study also demonstrate a low incidence of postoperative side effects. The nausea and vomiting scores were particularly low and likely were related to the reduced use of general anesthesia and opioid sparing effects of the anesthetic technique. This is a significant factor because nausea and vomiting is a major patient dissatisfier.[13] In this initial series of patients, there were no acute block complications or adverse neurological complications noted on the 24-hour or 7-day follow-up. In addition, the ability to aspirate and use incremental injection is also important to decrease the chance of unintentional intravascular injection. A potential disadvantage of the system is the 18-gauge needle diameter required to pass the 20-gauge catheter. Although not seen in this series of patients, an unintentional vascular puncture with

Table 4. Narcotic Analgesic Usage Postsurgery

Type of Continuous Nerve Block	% of Patients Requiring Oral or IV Narcotic in 1st 24 Hours (no.)	% of Patients Requiring ≥10 mg IV Narcotic in 1st 24 Hours (no.)	% of Patients Requiring Oral Narcotic at 7 Days Postoperation (no.)
Interscalene	59 (84)	4 (5)	60 (86)
Axillary	75 (3)	25 (1)	50 (2)
Lumbar plexus	74 (26)	14 (5)	50 (17)
Femoral	60 (3)	20 (1)	33 (1)
Sciatic	80 (33)	14 (6)	33 (14)

Abbreviation: IV, intravenous.

this needle could lead to a hematoma and theoretically to neural injury. In addition, another theoretical disadvantage with the use of an indwelling device for pain management is the potential for infection. If use of this system is extended into the second and third postoperative day, strict adherence to aseptic insertion technique is essential. However, previous reports have examined the relationship between duration of catheter use and bacterial culture of the catheter tip and failed to link duration with infection frequency.[14,15] Although showing a high success rate, this report is limited by the fact no direct comparison or randomization was made with other commercially available catheter systems. In addition, because the study population was discharged into the community at 24 hours, it was impossible to assess the quality and duration of the analgesia provided by the bolus of ropivacaine at 24 hours postsurgery.

Numerous studies have demonstrated the efficacy of CPNB for surgery.[16-19] However, previous studies have all focused on inpatients. The data in this study demonstrate that it is possible to achieve a high rate of success using this continuous catheter insertion system for patients in an ambulatory setting. CPNB offered excellent pain relief and few side effects, but was limited by the short duration of local anesthetic infusion. From the favorable results of this study, we conclude that a larger randomized prospective trial is needed to examine this system for a longer duration postsurgery on both inpatients and outpatients.

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