Fascia Iliaca Compartment Block for Femoral Bone Fractures in Prehospital Care

Sandrine Lopez, M.D., Thierry Gros, M.D., Nathalie Bernard, M.D., Christian Plasse, M.D., and Xavier Capdevila, M.D., Ph.D.

Background and Objectives: The fascia iliaca compartment block provides a faster and more consistent simultaneous blockade of the lateral cutaneous and femoral nerves than the "3 in 1" block. We studied the effectiveness of this technique for analgesia after a femoral bone fracture in pre-hospital care.

Methods: Patients with an isolated femoral shaft fracture were included. A fascia iliaca compartment block was performed on all of them. Twenty milliliters of lidocaine 1.5 % with epinephrine were injected under the fascia iliaca. The intensity of pain was measured using a simplified verbal scale (SVS) from 0 (no pain) to 4 (extreme pain). The SVS was noted before the block was performed, 10 minutes later, and then on admission to the trauma care center. Sensory blockade was evaluated using cold perception in the lateral, medial, and internal part of the thigh 10 minutes after block performance and on arrival at the trauma care center.

Results: Twenty-seven patients were enrolled in this study. The SVS was 3 (3-4) before the block, 1 (0-2) 10 minutes after the block, and 0 (0-1) when arriving at the trauma care center ($P < .05$). The SVS was lower when the internal part of the thigh was blocked.

Conclusion: The fascia iliaca compartment block is a simple, inexpensive, and effective method of prehospital analgesia for femoral shaft fracture. A sensory block of the internal part of the thigh is an early predictive sign of optimal pain relief. *Reg Anesth Pain Med 2003;28:203-207.*

Key Words: Regional analgesia, Prehospital care, Femoral shaft fractures.

The femoral nerve block is a safe, efficient, and easy method of analgesia for a fractured femoral shaft whether it is performed during prehospital management or on admission to the hospital.[1-3]

The fascia iliaca compartment block is an anterior lumbar plexus approach with a puncture point distant from the neurovascular sheath. A nerve stimulator is not necessary for this procedure. It was described for the first time in children in 1989.[4] It is widely used for postoperative analgesia after lower limb surgery in children and adults and provides effective postoperative analgesia after hip, femoral shaft, or knee surgery.[5] Compared with the "3-in-1" block, it provides a faster and more consistent simultaneous blockade of the lateral femoral cutaneous and femoral nerves.[5] Its use in prehospital care is anecdotal.6 As a nerve stimulator is not often available in ambulances, this would be an effective method of obtaining a lumbar plexus blockade. French physicians are present in prehospital units. In some cases, they are anesthesiologists. It could be valuable for them to become accustomed to the use of regional techniques in a prehospital setting.

In this prospective descriptive study, we evaluated the feasibility and efficacy of the fascia iliaca compartment block for analgesia after femoral shaft fracture in prehospital care.

Methods

After obtaining institutional approval and written informed consent, all patients suffering from an isolated femoral fracture (except femoral neck fractures) were included during a 1-year period (from January 1, 2001, to December 31, 2001). At the scene of the accident, the anesthesiologist was well aware of the necessity to give the information away from noise, out of the stress situation, alone with the patient, and before any mobilization. The patient was included only after the physician was sure he had fully understood all the information. The information given concerned risks and advantages

From the Department of Anesthesia and Critical Care Medicine, Lapeyronie University Hospital (S.L., N.B., C.P., X.C.), and Beau Soleil Clinic (T.G.), Montpellier, France.

Presented in part at the ASA Annual Congress, New Orleans, LA, October 13-17, 2001.

Reprint requests: Xavier Capdevila, M.D., Ph.D., Département d'Anesthésie Réanimation A, Hôpital Lapeyronie, 371 avenue du Doyen Giraud, 34295 Montpellier, France. E-mail: capdevila@chu-montpellier.fr

1098-7339/03/2803-0006$30.00/0
doi:10.1053/rapm.2003.50134

of a peripheral nerve block. The clinical diagnosis of femoral fracture was based on the trauma mechanism and thigh pain and deformation. Exclusion criteria were any other associated traumatic lesions, a Glasgow coma score other than 15, a known allergy to lidocaine, a neurologic deficit, or patients under 18 yrs of age. The fascia iliaca compartment block was carried out either at the scene of the accident or once the patient was in the ambulance. It was performed by senior anesthesiologists trained in emergency medicine and regional techniques.

All of the patients had a peripheral intravenous line and oxygen supply via a face mask. Electrocardiogram, noninvasive blood pressure, and oxygen saturation were monitored. No premedication or sedation was given. Resuscitation resources were always available. The fascia iliaca compartment block was performed as described by Dalens et al.[4] With the patient in a supine position, a projection of the inguinal ligament was drawn on the skin from the pubic tubercle to the anterior superior iliac spine and trisected. The puncture site was marked 1 cm caudal to the point at which the lateral met the middle third of the inguinal ligament line. After disinfecting the skin using topical 10% povidone-iodine, a short bevel needle (Plexufix® 50-mm 24-gauge) was inserted at a 90° angle to the skin. A first loss of resistance was felt as the needle's tip crossed the fascia lata. The needle was advanced further at the same angle until the second loss of resistance was felt as the fascia iliaca was pierced. Twenty milliliters of lidocaine 1.5% with epinephrine 1/200,000 were injected. No paresthesia was intentionally elicited.

Demographic data (sex, age, weight, height, American Society of Anesthesiologists [ASA] physical status) and fracture location (upper, middle or inferior third) were noted. The intensity of pain was measured using a simplified verbal scale (SVS) in which 0 represented no pain, 1 weak pain, 2 moderate pain, 3 significant pain, and 4 extreme pain. The SVS was noted before the block was performed, 10 minutes after the block, and on arrival at the trauma care center. Sensory blockade was evaluated using cold perception loss in the lateral, medial, and internal part of the thigh 10 minutes after local anesthetic injection and on arrival at the trauma care center. A complete block was defined as a block in all 3 parts of the thigh (medial, lateral, internal), a partial block was defined as a block in 1 or 2 parts, and a block failure was defined as no sensory block in any part of the thigh.

In case of insufficient analgesia, supplemental analgesic techniques were used at the discretion of the anesthesiologist on site. Signs of systemic toxicity to local anesthetic and all adverse effects were noted. Hypotension was defined as a systolic blood pressure lower than 80 mmHg and bradycardia as a heart rate below 50 beats/min.

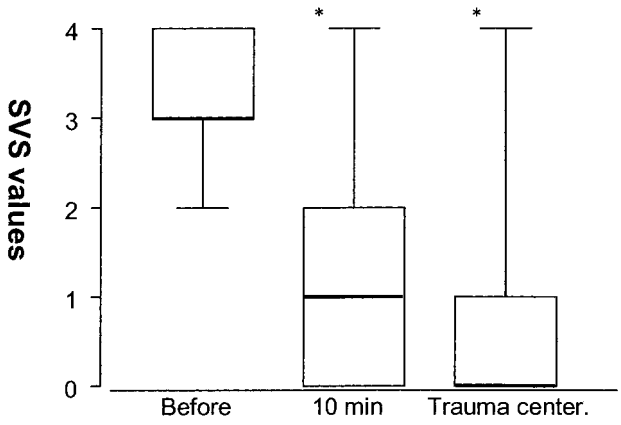

Fig 1. Comparison of the SVS values of pain before the block (before), 10 minutes after the block (10 min), and on admission to the emergency unit (trauma cent.). The box represents the 25th to 75th percentile. The dark line is the median. The extreme bars represent the 10th to 90th percentile. *$P < .05$ versus before the block.

Demographic data and SVS were expressed as median and 25th to 75th percentile. Because the time between the block performance and arrival at the trauma care center was not constant, the Friedman test was not applicable. Therefore, 2 SVS comparisons were made: one before the block performance and 10 minutes after it and another one before the block performance and arrival at the trauma care center. These 2 comparisons were performed using a paired Wilcoxon test. The comparisons of efficacy according to the sensory spread of anesthesia and according to the fracture location were also made using a Wilcoxon test. $P < .05$ was considered statistically significant.

Results

Twenty-seven patients, 21 men and 6 women, were included in this study. They were 26 (22-29) years old, 72 (62-75) kg in weight, and 172 (165-179) cm tall. Twenty patients were ASA I, 5 were ASA II, and 2 were ASA III physical status.

The SVS values are reported in Figure 1. The SVS decrease 10 minutes after block placement was statistically significant ($P = .000001$), as was the decrease on arrival at the trauma care center ($P = .000001$). The median time between the block performance and arrival at the hospital was 40 (20-55) minutes.

The medial part of the thigh mainly corresponding to femoral nerve sensory distribution was blocked in 92.6% of the cases 10 minutes after the block and in 96.3% on arrival at the trauma care

Table 1. Correlation Between SVS Values on Arrival at the Trauma Center (median [range]) and Sensory Block of the Thigh

Sensory Block of the Thigh	Median SVS Values if No	Median SVS Values if Yes	*P*
Lateral and internal parts together	1 (0-2)	0 (0-0)*†	.01*, .01†
Internal part	1 (1-2)	0 (0-0)*†	.01*, .01†
Lateral part	1 (0-2)	1 (0-1)‡	.96‡

NOTE. Twenty-six patients had a sensory block of the medial part of the thigh. Better pain relief was obtained when the internal part of the thigh had a sensory block.
*Versus absence of sensory block in the internal part of the thigh.
†Versus absence or presence of sensory block in the lateral part of the thigh.
‡Versus absence of sensory block in the lateral part of the thigh.

center. The lateral part of the thigh was blocked in 37% of cases 10 minutes after the block and in 51.9% when arriving at the trauma care center. The internal part of the thigh was blocked in 22.2% of the cases 10 minutes after the block and in 37% when arriving at the trauma care center.

There was 1 block failure. Seven patients had a complete block, and 19 had a partial block. The 7 patients who had a complete block and 18 out of 19 patients who had a partial block required no further analgesia (SVS < 3). The 1 remaining patient out of the 19 who had a partial block and whose SVS has decreased from 4 to 3 in the first 10 minutes benefited from supplemental femoral nerve block with a nerve stimulator. And, finally, the patient who presented the block failure underwent general anesthesia in the emergency unit.

The SVS distribution compared with the spread of the sensory block is given in Table 1, at the trauma care center arrival. Ten minutes after the block was performed, and, on arrival at the trauma care center, the median SVS was lower when the internal part of the thigh was blocked. The SVS decrease during the first 10 minutes was higher when the internal part of the thigh was blocked (-2.8 *v* -1.6; $P = .004$).

Whatever the location of the femoral fracture (superior, median, or inferior third), there was no difference with regard to pain relief. No adverse effects or signs of local anesthetic systemic toxicity, hypotension, or bradycardia were noted. There were no vascular punctures, and no paresthesia was elicited. All patients indeed suffered from a femoral fracture, and all required surgery in the 24 hours after arrival at the trauma center.

Discussion

This descriptive prospective study shows that effective pain relief can be provided by prehospital fascia iliaca compartment blocks for most patients with a femoral shaft fracture. Sensory block to the internal part of the thigh was an early sign of optimal pain relief. This technique is very efficient, safe, and easy to perform in prehospital care, and the equipment used is inexpensive.

In European countries and France in particular, physicians are present in ambulances. Sometimes the physician is an anesthesiologist, and it seems logical and no more expensive to apply techniques with which they are familiar. Our study was performed with a prehospital team that included anesthesiologists. Its conclusion cannot be extended to other practitioners. To perform such techniques outside the hospital, the physician must be trained to perform them inside the hospital first and be fully aware of the possible complications and treatment of side effects.

Obtaining informed consent from these traumatized patients was not a problem. The information the anesthesiologist gave them concerning the regional technique was exactly the same as he would have given them in a hospital setting.

This is a descriptive study that aimed to evaluate the feasibility and efficacy of a fascia iliaca compartment block for prehospital management of femoral fractures. Because we did not perform a comparative study between the peripheral nerve block and intravenous analgesia, we cannot confirm the overall superiority of this technique.

Femur fractures require rapid and optimal treatment including fluid loading, analgesia, and immobilization.[7-8] Femoral nerve blocks have often been used for femoral shaft or neck fracture analgesia in prehospital care[1-3,8,9] or in emergency departments.[10] All these studies used paresthesia techniques. This kind of technique is no longer recommended in intrahospital practice in Europe[11] where nerve stimulation is mainly used. It therefore seems logical not to use it in prehospital care either because the description of paresthesia by a patient suffering from a fracture is often difficult to interpret. Nerve stimulators and insulated needles are not often available in all ambulances. They are expensive devices and require maintenance costs. Furthermore, the quadriceps twitches induced by the nerve stimulator are painful for a patient suf-

fering from a femoral shaft fracture. For these reasons, we recommend the fascia iliaca compartment block. The fascia iliaca compartment block equipment (a short bevel needle only) is simple. The block performance does not induce a paresthesia or muscle contraction. The patient must be lying down, and the landmarks are not modified by the shaft fracture.

Various approaches to the lumbar plexus block have been studied. Winnie et al.[12] described the "3-in-1 block" as a multiple nerve block of the lumbar plexus obtained with a single injection. This technique has been compared with the fascia iliaca compartment block in children[4] and adults.[5] In these 2 studies, the fascia iliaca compartment block was more effective than the "3-in-1" block in producing simultaneous blockade of the femoral nerve and the lateral femoral cutaneous nerve. Our success rate is high and comparable with the in-hospital data. A sensory block of the medial part of the thigh or the association of sensory blocks in the medial, lateral, and internal parts of the thigh were obtained in 96% and 26%, respectively, in our study versus 88% and 34% in the study of Capdevila et al.[5] Our failure rate was 7.4%. Failure rate varies from 0% to 10% in different studies performed in prehospital care and in which femoral shaft fracture analgesia was performed using a femoral block.[1-3,13,14] Therefore, the fascia iliaca compartment block failure rate is comparable with that obtained using a prehospital care classic femoral block.

The decrease in SVS values during the first 10 minutes was higher when the internal part of the thigh was blocked. A sensory block of the internal part of the thigh is an early sign of efficient spreading of local anesthetic and can predict optimal pain relief for the patient. On the contrary, the absence of sensory block on the internal part of the thigh is a way of informing the physician that the fascia iliaca compartment block probably requires supplementation such as with class IV opioids. Many studies have previously considered that the obturator nerve innervated the internal part of the thigh. But, as Parkinson et al.[15] pointed out, the only reliable indication of successful obturator nerve block is paralysis of the adductor muscles of the thigh. The cutaneous innervation from the obturator nerve to the medial aspect is variable and often missing, in which case the femoral nerve gives this sensory innervation.[16] In our study, we chose not to test the obturator nerve as adductor muscle contraction might be painful for a patient with a femoral shaft fracture.

The use of a fascia iliaca compartment block rather than a traditional "3-in-1" femoral nerve block should provide an additional margin of safety because the needle is inserted into an area away from the femoral nerve and vessels. However, one case of postoperative neuropathy after fascia iliaca compartment blockade was described when the block was performed under spinal anesthesia[17] and vessel puncture may have occurred.[18] These incidents are rare but justify asking the patient to describe any pain during performance of the block. The local anesthetic infusion must be performed over a 2-minute period and interrupted by aspirations. We chose to use lidocaine 1.5% with epinephrine because it is a short-acting local anesthetic. Its duration is sufficient to allow reduction, transport, and radiograph management when arriving at the emergency unit. Surgery is often performed more than 2 hours after the accident, at which time the hospital anesthetist can perform a femoral block by using a nerve stimulator. If the patient should enter the operating room sooner, a fascia iliaca block can be performed with or without a catheter whether the prehospital block is finished or not.

We conclude that the use of a fascia iliaca compartment block in prehospital care provides good pain relief for most patients and therefore improves surgical management of femoral shaft fractures.

Acknowledgment

The authors thank Ph. Cabanel, M.D., J. B. Martin Dupont, M.D., E. Hatterer, M.D., D. Prost, M.D., for their clinical help.

References

1. Barriot P, Riou B, Ronchi L, Bellaiche S. Femoral nerve block in prehospital management of fractured shaft of femur. *JEUR* 1988;1:21-24.
2. McGlone R, Sadhra K, Hamer DW, Pritty PE. Femoral nerve block in the initial management of femoral shaft fractures. *Arch Emerg Med* 1987;4:163-168.
3. Haddad FS, Williams RL. Femoral nerve block in extracapsular femoral neck fractures. *J Bone Joint Surg Br* 1995;77:922-923.
4. Dalens B, Vanneuille G, Tanguy A. Comparison of the fascia iliaca compartment block with the 3-in-1 block in children. *Anesth Analg* 1989;69:705-713.
5. Capdevila X, Biboulet PH, Bouregba M, Barthelet Y, Rubenovitch J, d'Athis F. Comparison of the three in one and fascia iliaca compartment blocks in adults: Clinical and radiographic analysis. *Anesth Analg* 1998; 86:1039-1044.
6. Gros T, Hatterer E, Plasse C, De La Coussaye JE. Bloc iliofascial en médecine préhospitalière. *Ann Fr Anesth Réanim* 1999;18:282-283.
7. Burgess AP, Poka A. Musculoskeletal trauma. *Emerg Med Clin North Am* 1984;4:871-882.

8. Dissait F, Gonzalez D, Meyrieux J, Barriere A, Dufour F, Billaud C. Prise en charge pré-hospitalière des fractures diaphysaires du fémur. *JEUR* 1989;2:107-110.
9. Berry FR. Analgesia in patients with fractured shaft of femur. *Anaesthesia* 1977;32:576-577.
10. Finlayson BJ, Underhill TJ. Femoral nerve block for analgesia in fractures of the femoral neck. *Arch Emerg Med* 1988;5:173-176.
11. Aknin PH. Anesthésie locorégionale francophone. Available at: http://www.alrf.asso.fr. Accessed
12. Winnie AP, Ramamurthy S, Durrani Z. The inguinal paravascular technic of lumbar plexus anesthesia: The "3-in-1" block. *Anesth Analg* 1973;52:989-996.
13. Virenque CH, Gaston JP. Bloc du nerf crural pour fracture de la diaphyse fémorale. *Can Anesthesiol* 1983;4:365-366.
14. Beruben A, Pellerin M, Cavagna P, Leclercq G. Anesthésie locorégionale en Aide Médicale Urgence. *Rev SAMU* 1990;6:250-253.
15. Parkinson SK, Mueller JB, Little WL, Bailey SL. Extend of blockade with various approaches to the lumbar plexus. *Anesth Analg* 1989;68:243-248.
16. Bouaziz H, Vidal F, Jochum D, Macalou D, Heck M, Meuret P, Braun M, Laxenaire MC. An evaluation of the cutaneous distribution after obturator nerve block. *Anesth Analg* 2002;94:445-449.
17. Atchabahian A, Brown AR. Postoperative neuropathy following fascia iliaca compartment blockade. *Anesthesiology* 2001;94:534-536.
18. Lopez S, Gros T, Dareau S, Roche B, Vergnes C, Capdevila X, Eledjam JJ. Morbidité et extension de 450 blocs iliofasciaux. *Ann Fr Anesth Réanim* 2001;20: R118 (abstr).