Case Series

Deep fascia iliaca block combined with sacral plexus block for hip fracture surgery: A retrospective series of cases

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ABSTRACT

This case series describes a novel anaesthetic approach for hip fracture surgery using the deep fascia iliaca block combined with the sacral plexus block. This single-centre, retrospective study involved 15 patients aged 85 years or older and having significant cardiac disease. All the patients were managed with single-shot deep fascia iliaca block (22 or 25 ml of ropivacaine 0.5%) and sacral plexus block (12 or 15 ml of ropivacaine 0.5%, according to the patients' weight) after the administration of 50 μg of fentanyl intravenously. Intraoperatively, the patients were also administered light-to-moderate sedation. All patients presented a successful sensory block and a high level of haemodynamic stability (nil vasopressor consumption). In hip fracture surgery, low volume deep fascia iliaca block may be combined with sacral plexus block as primary anaesthetic technque, without any neuraxial technique or sympathetic blockade.

Key words: Deep fascia iliaca block, sacral plexus block, hip fracture, analgesia, cardiac disease

INTRODUCTION

Modified regional techniques have been proposed in high-risk cardiac patients to reduce the haemodynamic impact of the standard dose single-shot spinal anaesthesia; nevertheless, titrated neuraxial techniques that attempt to minimise hypotension, such as continuous spinal anaesthesia, may lead to significant vasopressor consumption.[1] The current study describes a novel approach for hip fracture surgery using the deep fascia iliaca (DeFI) block combined with the sacral plexus block. The primary objective of this case series was to demonstrate the reliability of the anaesthetic approach (including haemodynamic stability, complaints during the procedure, and differences in the numerical pain rating scale [NPRS] between the preoperative and postoperative periods at 24 hours). Eventual intraoperative complications and unplanned intraoperative opioid consumption were also reported.

CASE SERIES

This retrospective case series was approved by the hospital's ethics committee dated 13/12/2021. It was conducted by the ethical standards of the institutional committee on human experimentation (institutional or regional) and with the Declaration of Helsinki of 1975, as revised in 2013. The patients granted written consent for their anaesthetic approach. They were anaesthetised in a tertiary hospital between January and October 2021.

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Fifteen consecutive patients aged 85 years or older, with American Society of Anesthesiologists (ASA) physical status IV, with significant cardiac disease [Table 1], proposed for surgical repair of hip fracture (internal [n = 8] and external fixation of femoral neck fractures [n = 2], and hemiarthroplasty [n = 3] or total arthroplasty [n = 2]) were studied. The patients were monitored using the ASA standard monitoring, invasive arterial pressure, and urinary output (hourly). All the patients were anaesthetised with a single-shot DeFI block (22 or 25 ml of ropivacaine 0.5%, according to the patients' weight) plus sacral plexus block (12 or 15 ml of ropivacaine 0.5%, according to the patients' weight) after the administration of 50 μg of fentanyl (intravenously).

For the DeFI block, the patient was maintained at supine position and a high-frequency probe (12 MHz; Fujifilm Sonosite M-Turbo, Bothell, WA, USA) was placed immediately distal to the anterior superior iliac spine and orientated toward the umbilicus [Figure 1a]. The fascia iliaca (FI) was observed in the ultrasound image (depth setup: 6 cm) deepening down posteriorly, medially, and obliquely but parallel to the iliac bone. The needle was advanced in-plane, at about 60° to the skin, and beneath the FI. During the injection (4–5 cm from the skin), the local anaesthetic (LA) pushed down the iliac muscle and lifted the FI [Figure 1a].

After confirmation of sensory block on the anterior, lateral, and medial compartments of the thigh, a sacral plexus block was performed in the lateral decubitus position based on the description by Taha[2] for the parasacral sciatic block [Figure 1b]. The patient was positioned in lateral decubitus, and with the help of a low-frequency probe (4 MHz; Acuson 300, Siemens, Melsungen, Germany) placed in an axial plane and 8 cm lateral to the uppermost point of the gluteal region, the posterior border of the ischium at the upper portion of the great sciatic foramen was identified. Moving the probe distally after the identification of the iliac bone (straight oblique line), the hyperechoic plexus was seen lying deep into the piriformis muscle lateral to the inferior gluteal vessels. It should not be ignored that the superior gluteal nerve exits in the lateral direction between the upper margin of the sciatic foramen and the upper edge of the piriform muscle;[2] therefore a cranial tilt of the probe is recommended for a proximal and broader sacral plexus block [Figure 1b]. After elicitation of the sciatic nerve response by electric simulation (plantar or dorsiflexion of the foot between 0.2 and 0.5 mA and at 2 Hz), 12 or 15 ml of ropivacaine 0.5% was injected. Fifteen minutes after the injection, the sensory block was confirmed in the posterior thigh.

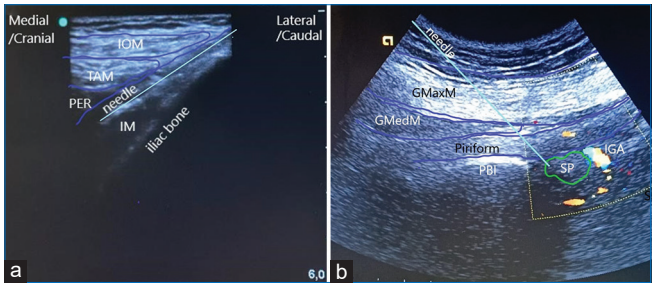

Figure 1: (a) Ultrasound imaging for deep fascia iliaca block. FI = Fascia iliaca; IL = Inguinal ligament; IM = Iliac muscle; IOM = Internal oblique muscle; IP = Injection point; LA = Local anaesthetic; PER = Peritoneum; SM = Sartorius muscle; TAM = Transverse oblique muscle. (b) Ultrasound imaging for the sacral plexus block. GMaxM = Gluteus maximum muscle; GMedM = Gluteus medius muscle; IGA = Internal gluteal artery; PBI = Posterior border of ischium. In this image, the vessel observed deeply to the sacral plexus are probably the internal pudendal artery but is not considered an important landmark for the performance of the block

Patients were then sedated using target-controlled infusion (Syringe BBraun, Melsungen, Germany) of propofol (target level 0.5 to 1.0 μg/ml; Fresenius Kabi Pharma, Santiago de Besteiros, Portugal), under the Schnider model, to attain a University of Michigan Sedation Scale (UMSS) score between 1 and 2. The statistical analysis was performed using the Statistics Kingdom software (Melbourne, Australia; available freely online at statskindom.org).

All the patients presented a successful sensory block in all the thigh compartments (confirmed by loss of thermal sensation and pain sensation to the pin-prick test) and a high level of haemodynamic stability with nil vasopressor consumption. No statistically different values were observed on comparing the preoperative and

Table 1: Prevalence of significant cardiac comorbidities in the 15 patients of the study

Comorbidity	Number of patients	Additional details
Significant valvular disease	10	Including 5 patients with severe aortic stenosis
Coronary disease	8	
Dysrhythmia	10	
Cardiac failure	10	Including 5 patients with ejection fraction <45%
Presence of pacemaker	4	
Pulmonary hypertension	8	Including 4 patients with severe pulmonary hypertension

Note: Four patients were submitted previously to lumbar spine surgery

intraoperative mean arterial pressure values (Wilcoxon signed-rank test, one-tailed; $P = 0.52$). No patient complained of pain intraoperatively. No tachycardia or hypertensive events were noted, and no additional opioids were given. In two patients, skin infiltration with lidocaine 2% (3 ml) was needed to cover the subcostal (T12)/ilio-hypogastric or, eventually, the lateral superior cluneal nerve innervations. The blood loss was minimal, at a median of 200 ml (interquartile range: 150–250 ml). All the patients remained in the post-anaesthesia care unit for six hours without requiring intravenous analgesia. Preoperatively, in the operating theatre, the patients presented a numerical pain rating score (NPRS; median [interquartile range]) of 7 (6–9). In all the patients, the NPRS lowered to <3 out of 10 during the first 24 hours postoperatively and to <2 out of 10 at the time of transfer to the ward. The Wilcoxon signed-rank test comparing preoperative NPRS with the NPRS at 24 hours showed statistically significant difference (difference in NPRS; mean [standard deviation] = 7 [1.10]; $P < 0.001$).

DISCUSSION

The muscular, cutaneous, and osseous innervation of the hip region from the lumbar plexus depends on the femoral nerve (branches for the hip joint arising infra-inguinally and supra-inguinally), obturator nerve (ON), accessory obturator, and the lateral femoral cutaneous nerve. The femoral branches of the genitofemoral, iliohypogastric, ilioinguinal, subcostal, and superior cluneal nerves are rarely relevant for hip surgery. The muscular, cutaneous, and osseous innervation for the hip from the sacral plexus rely on the nerves to quadratus femoris gemellus inferior, gluteus inferior, and gluteus superior.[2,3] While the lumbar plexus is responsible for the anterior capsule innervation, where a high density of nociceptors are present, the sacral plexus is responsible for the posterior capsule innervation, where, in opposition to the anterior capsule, a high density of mechanoreceptors are present.[2-4]

The DeFI block should allow a reliable blockade of the anterior branches of the lumbar plexus due to a different injection site from the supra-inguinal fascia iliaca (S-FI) block.[3] A study conducted by Vermeylen *et al*.[5] demonstrated that an effective ON block after an S-FI block depends on the ability of the LA to reach the posterior-medial border of the psoas major muscle (PMM) at a level above the body of S1 vertebra. The DeFI block, with an injection site far more cranial/medial/posterior (deeply, near the lateral border of the PMM) than in the S-FI block and in a posterior-medial-cranial direction, will increase the likelihood of significant contact of the LA with the ON posteriorly and to the PMM medially above the body of S1, by promoting LA spread between the iliac muscle and PMM at this region, where the retropsoas space is wider and penetrable.[3] Bendtsen *et al*.[6] claimed that the LA is never observed medial to the linea terminalis with the S-FI block. In fact, the ON is not within the FI compartment in the lesser pelvis, but only in the greater pelvis above S1, with the linea terminalis not being an anatomical reference at this level.[6,7] The DeFI block, combined with ultra-low dose of spinal anaesthesia, has shown to be a reliable alternative approach, but some vasopressor consumption has been still reported.[3]

The combination of posterior lumbar plexus, lumbar paravertebral, erector spinae plane, or quadratus lumborum blocks with the sacral plexus block may lead to unwanted neuraxial LA spread or may be unreliable.[8–12] In fact, the rami of the anterior branches of the lumbar plexus may be as close together at the proximal level of the FI compartment than in the psoas compartment region due to the spinal multilevel contribution at the lumbar level.[6] The supra-inguinal FI block alone, using 35 ml of LA, has been described for intramedullary hip fixation (not for hip arthroplasty) but deep sedation was required.[13]

The use of a FI block combined with a sacral plexus block has not yet been described in high-risk cardiac patients scheduled for hip surgery, probably due to the higher quantity of LA required for a successful anaesthetic technique; therefore, the DeFI block is a step forward in this context. In our study, in none of the patients, the drug crossed the prescribed toxic dose levels (total amount of ropivacaine given was 170 mg in 3 patients and 200 mg in 12 patients).

CONCLUSION

The DeFI block has expanded the role of the FI blocks; it is now possible to combine a FI block with a sacral plexus block as a primary anaesthetic technique in hip fracture surgery while avoiding toxic doses of LA without significant dilution and sympathetic block related to the use of psoas compartment block or neuraxial anaesthesia. Further studies are necessary to confirm the results of our case series. This novel technique optimises postoperative analgesia and

intends to reduce the risk of the intervention and shorten the time for surgical recovery.

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Conflicts of interest

There are no conflicts of interest.

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