Rev Bras Anestesiol. 2020;**70(2)**:178–183

Sociedade Brasileira de Anestesiologia

Brazilian Journal of ANESTHESIOLOGY

Revista Brasileira de Anestesiologia

CASE REPORTS

Paraspinous Sagittal Shift (PSSS): a novel approach for transmuscular quadratus lumborum block for hip surgery analgesia – four cases report

Ahmad S. Alabd, Moustafa A. Moustafa *, Aly M.M. Ahmed

Alexandria University, Faculty of Medicine, Department of Anesthesia and Surgical Intensive Care, Alexandria, Egypt

Received 18 March 2019; accepted 3 January 2020
Available online 28 April 2020

KEYWORDS
Quadratus lumborum;
Block;
Hip

Abstract
Background: Effective pain management is essential for successful rehabilitation and enhanced recovery after joint arthroplasty. The Quadratus Lumborum Block (QLB) has mostly been described for abdominal surgery, but has also recently been applied to hip surgery patients.
Methods: In the following cases series, we suggest a modification of the TQL block described as Paraspinous Sagittal Shift QL block. We hypothesize that this approach may allow better LA spread to the lumbar nerve roots. Such technique involves a craniocaudal approach of LA injection between the QL and PM muscles behind the Anterior Thoracolumbar Fascia (ATLF) at the level of L4. Cases were provided with combined GA and PSSS modification of QL block via a single shot or catheter technique.
Results: Sensory distribution of the block in the four patients studied was found to cover the area between the T11–12 and L4–5 dermatomes. Spread of the injectate was confirmed via an A–P fluoroscopy imaging of the lumbosacral spine after injection of a mixture of LA and a contrast in the plane between the QL and PM muscles in two cases.
Conclusions: The PSSS technique for TQL block may be beneficial as a part of multimodal analgesia for hip surgeries. This technique may be a safe alternative to psoas compartment block; however, future comparative studies are recommended. The PSSS technique for TQL block also may provide an easy access for catheter insertion.

* Corresponding author.
E-mails: m.3abdelaziz@hotmail.com, moustafa.abdelaziz@alexmed.edu.eg (M.A. Moustafa).

https://doi.org/10.1016/j.bjane.2020.04.006

PALAVRAS-CHAVE
Quadrado lombar;
Bloqueio;
Quadril

Paraespinhoso Sagital (PES): nova técnica no bloqueio transmuscular do quadrado lombar para analgesia em cirurgia de quadril – relato de quatro casos

Resumo:
Justificativa: O controle efetivo da dor é essencial para a reabilitação bem sucedida e melhor recuperação após artroplastia. O bloqueio do quadrado lombar tem sido descrito principalmente para cirurgia abdominal, mas também tem sido usado recentemente para pacientes submetidos a cirurgia de quadril.
Método: Na série de casos a seguir, sugerimos modificação na técnica do bloqueio transmuscular do quadrado lombar descrita como bloqueio do Quadrado Lombar Paraespinhoso Sagital (PES). Nossa hipótese é de que a técnica permitiria melhor dispersão do anestésico local para as raízes dos nervos lombares. Tal técnica envolve acesso craniocaudal para injeção do anestésico local entre os músculos quadrado lombar e psoas maior atrás da Fáscia Toracolombar Anterior (FTLA) no nível de L4. Os casos foram submetidos a anestesia geral combinada a técnica modificada PES para bloqueio do quadrado lombar via injeção única ou cateter.
Resultados: Verificou-se que a distribuição sensorial do bloqueio nos quatro pacientes estudados cobriu a área entre os dermátomos T11–12 e L4–5. A dispersão do anestésico injetado foi confirmada via fluoroscopia A–P da coluna lombo sacral após injeção, em dois casos, de solução de anestésico local e contraste no plano entre os músculos quadrado lombar e psoas maior.
Conclusões: A técnica PES para bloqueio transmuscular do quadrado lombar pode ser benéfica como componente da analgesia multimodal para cirurgias de quadril. A técnica pode ser alternativa segura para bloqueio do compartimento psoas; entretanto, estudos comparativos futuros são recomendados. A técnica PES para bloqueio transmuscular do quadrado lombar pode também fornecer acesso fácil para inserção do cateter.

Background

The hip surgery patient population worldwide is quite diverse, from children with congenital hip dysplasia, to younger athletic adults who undergo hip arthroscopy, to frail elderly patients with multiple medical problems. It is a major surgery causing severe postoperative pain. Although pain during rest is usually considerably reduced, mobilization is important in terms of thromboembolic complications.[1]

Effective pain management is essential for successful rehabilitation and enhanced recovery after joint arthroplasty. In this context, appropriate application of regional anesthesia and analgesia continues to play an important role in perioperative pain management.[2]

Psoas Compartment Block (PCB) is an efficient analgesic technique and is considered the gold standard regional anesthetic technique for hip surgery. However, the PCB is a technically difficult deep block, associated with a relatively high incidence of complications. In addition, multiple needle passes may be required to obtain the appropriate needle position and elicit the required motor response.[3]

Quadratus Lumborum Block (QLB) has been described mostly for abdominal surgery, but recently has been applied for neck of femur fracture and hip surgery patients. For the Transmuscular QL (TQL) block, the Local Anesthetic (LA) is injected between the Psoas Major (PM) muscle and the Quadratus Lumborum muscle (QL). Branches of lumbar plexus nerves run between the PM and the QL, hence the anterior QLB may play a role in analgesia not only for the trunk, but for the lower extremities as well.[4] Many case reports have evolved discussing the use of TQL block (anterior QL) in hip surgeries extending through T10 to L3–L4 dermatomes. Several previous studies documented a consistent spread of TQL to reach L3–4 dermatomes.[5]

In the following case series, we suggest a modification of the TQL block involving a craniocaudal approach of LA injection between the QL and PM muscles just after piercing QL epimysium. This may allow LA spread behind the Anterior Thoracolumbar Fascia (ATLF) at the level of L4 (Fig. 1). We hypothesize that this approach may achieve better caudal spread to the nerves covered with the fascia iliaca, with a potential for medial spread to the ventral rami of L2 and L3, in addition to a possibility of blocking the nerves passing anterior to the QL muscle, including subcostal, ilioinguinal and iliohypogastric nerves. The technique is described as Paraspinous Sagittal Shift QL block, done at L4 transverse process level in a sagittal orientation.

Methods

This prospective study was approved by Alexandria University's institutional review board. This study was registered in Clinical Trial Registry (NCT03733769, principal investigator: Alabd AS, date of registration: 6th of November, 2018. Four consecutive cases undergoing elective hip surgery were prospectively recruited. Informed written consent for the perioperative analgesia technique was obtained from the four cases participating in the study. A written consent was obtained from the first two cases for the insertion of a catheter in the targeted plane for continuous analgesia,

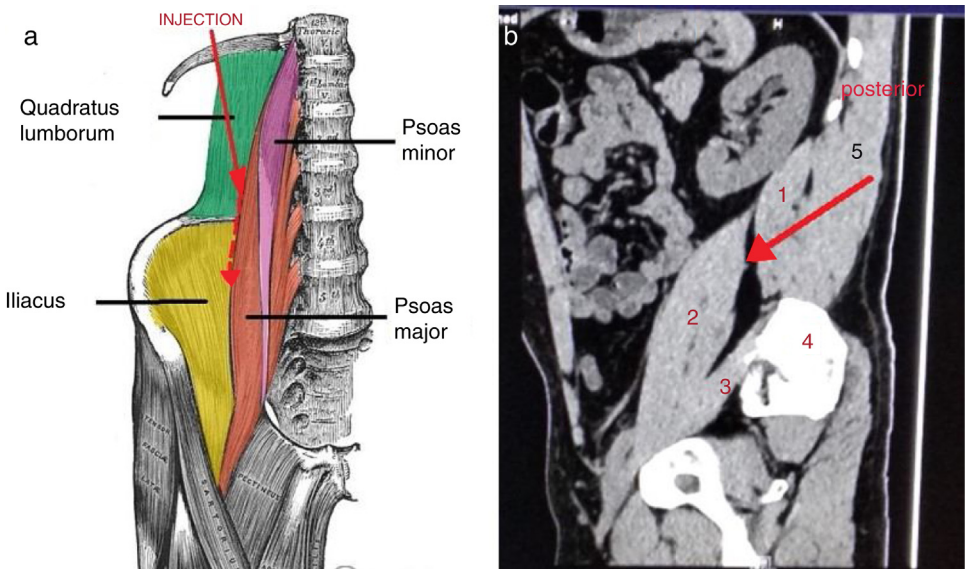

Figure 1 (a) Diagrammatic representation of the supposed direction of spread of injection caudally between quadratus lumborum (QL) and psoas major (PM) muscle. Reproduced with the permission from TeachMeAnatomy. (b) Sagittal CT scan for a volunteer at the level of the apex of the transverse process of L4. (1) QL muscle; (2) PM muscle; (3) Iliacus muscle; (4) Iliac crest; (5) Erector spinae muscle. Red arrow represents the direction of injection and endpoint. Potential plane between psoas major and quadratus lumborum is supposed to enable the injected local anesthetic to spread caudally at postero-lateral surface of PM and beyond fascia iliaca over iliacus muscle.

and from the third and fourth cases for injection of LA mixed with a non-ionized contrast material; Ultravist 300 (Iopromide 300 mg I.mL^{-1}, Schering AG, Berlin, Germany) for confirmation of its spread using a C-Arm fluoroscopy machine in the operating theatre. Eligible cases were those admitted for total or hemi-arthroplasty or fixation of femur neck fractures in Alexandria University hospitals. Patients were not eligible if they have had any kind of coagulopathy, known spine deformity or allergy to local anesthetics. Regional blocks were performed preoperatively. Intravenous access and routine monitoring (pulse oximetry, electrocardiogram and noninvasive blood pressure) were established prior to block performance. Preparation was completed with a sterile technique. All blocks were performed by a single investigator (A.S.A.), while block assessment was done by a second investigator (A.M.M.A) for 30 minutes after block performance using a pin prick test for dermatomal distribution and a 6 point numerical rating scale (MRC – scale)[6] for quadriceps muscle power evaluation. Then, patients were transferred to the Operating Room (OR), where standard general or spinal anesthesia was determined by the anesthesiologist in charge of the patient. Standard multimodal analgesia protocol was applied in all patients with the block constituting the main arm of the protocol. Thirty ml of 0.25% bupivacaine were injected in the targeted plane. In the first two cases where a catheter was inserted, regional analgesia was maintained with an infusion of 0.125% bupivacaine at a rate of 6 mL.hr^{-1} for 48 hours postoperatively. In addition to the block, multimodal analgesia protocol included dexamethasone 8 mg given intraoperatively and paracetamol 1 g and ketorolac 30 mg given 20 minutes before recovery and continued as paracetamol 1 gm/8 hours and ketorolac 15 mg/12 hours intravenously postoperatively for 48 hours.

Block description

With the patient in the prone (Fig. 2), lateral decubitus or modified Sims position and the block side independent, a curvilinear ultrasound transducer (2–5 MHz) (Sonosite, M-turbo, Bothell, WA, USA) was directed caudally in a sagittal plane 3–4 cm lateral to the lumbar spinous process of L4, which is almost opposite to the iliac crest, producing a longitudinal scan of the lumbar paravertebral region; and thus identifying the transverse processes of L3 and L4, with PM muscle in-between and erector spinae muscle posteriorly.

The probe is shifted slowly to the lateral side until the transverse processes disappear and the QL muscle is evident in its long axis attached caudally to the iliac crest with a characteristic sonographic image of three muscle layers appearing from posterior to anterior as: erector spinae, QL, and PM muscles respectively. Here, ATLF – which is considered as continuation of fascia transversalis – is seen separating QL and PM muscles.

After subcutaneous local infiltration with lidocaine at the cephalic end of the probe, the block needle is advanced in a cephalo-caudal direction, through the erector spinae and QL muscles, until it pierces the epimysium of the QL. LA is injected anterior to the QL muscle, observing its spread in a caudal direction towards the iliac crest between the QL and psoas muscles.

In the first two cases, a catheter was inserted after hydrodissection of the plane by LA injection.

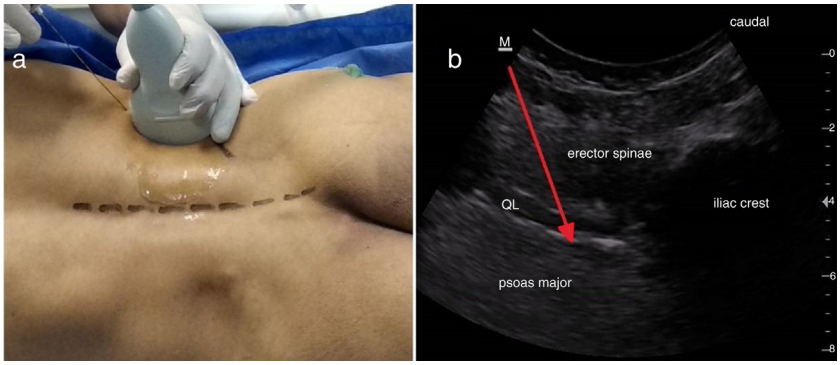

Figure 2 (a) Probe position and needle direction, (b) Characteristic sonographic image of triple muscle layers from posterior to anterior: Erector spinae, Quadratus Lumborun (QL), and Psoas Major (PM) muscles, respectively. Anterior thoraco-lumbar fascia is seen separating QL and PM muscles. Red arrow represents needle path to endpoint of injection.

Patient management

Case 1

A 66 year-old, 75 kg female patient with a medical history of hypertension and rheumatoid arthritis was posted for Total Hip Arthroplasty (THA) through anterior approach. A combined GA and QL block via the PSSS approach was planned.

The targeted plane was approached with the patient in the modified Sim's position via a Tuohy needle, and a catheter was advanced until its tip was projecting 4 cm beyond the needle tip. The catheter was tunneled under the skin and covered with sterile dressing. After 30 minutes of LA injection, a pinprick test revealed a sensory block between the T11 and L4 dermatomes, with no weakness of the quadriceps muscle on knee extension.

GA was induced with 100 μg fentanyl, 2 mg.kg^{-1} propofol and 0.5 mg.kg^{-1} atracurium for muscle relaxation and tracheal intubation. Anesthesia was maintained with 1%–2% isoflurane and increments of atracurium. The patient did not require additional opioids intraoperatively. The patient's recovery was free of pain. Analgesia was maintained throughout the postoperative period via the LA infusion via the catheter with a VAS score ranging between 0 and 2 during rest and physiotherapy respectively, and an MRC scale score of 5.

Case 2

A 64 year-old 84 kg male patient was scheduled for a right THA due to osteo-arthritis through the lateral approach. A combined GA and QL block via the PSSS approach was planned. The targeted plane was approached with the patient in the left lateral decubitus position via a Tuohy needle, and a catheter was advanced until its tip was projecting 4 cm beyond the needle tip. Thirty minutes after the block performance, the patient reported reduced sensation to pinprick over the T12–L4 dermatomes ipsilateral to the site of the block, with an MRC scale score of 4 on knee extension. During the patient's stay in the PACU for 48 hours, a rescue dose of 3 mg intravenous morphine at 12 hours post-operatively was required by the patient when the VAS score exceeded 3 during physiotherapy. Otherwise, VAS scores ranged between 0 and 3 during rest and physiotherapy respectively, with an MRC scale score of 5 during the first 48 hour postoperative period.

Case 3

A 54 year old, 80 kg female patient with a history of breast cancer operated upon four years ago, followed with hormonal therapy and radiotherapy with metastasis to the lumbar spine. The patient presented with a fracture of the neck of the femur and was scheduled for hip bipolar hemi-arthroplasty. GA combined with the same approach was planned. A 22G spinal needle was used, and 30 ml of bupivacaine 0.25% containing 5 mL of a non-ionized contrast material was injected into the targeted plane. Fifteen minutes after block performance, the patient reported complete regression of pain in the right hip area, with a reduced sensation to pinprick over the T12–L4 dermatomes ipsilateral to the site of the block, with an MRC scale score of 4 of the quadriceps muscle.

A frontal radiograph of the lumbosacral region of the blocked side was done to observe the pattern of LA spread, using the C-Arm fluoroscopy machine in the OR. It revealed a pattern of spread at the course of the PM muscle into the pelvis, with extension of spread medially and caudally beyond the level of the L5 lumbar vertebra. No rescue analgesia was requested by the patient for 18 hours postoperatively.

Case 4

A 71 year-old, 110 kg female patient with a history of hypertension and type II diabetes mellitus, presented for fixation of a fracture of the neck of the femur using a dynamic hip screw. A single shot QL block using the PSSS approach was planned as a part of the multimodal analgesia protocol, and a mixture of LA contrast was injected followed by an A–P fluoroscopy imaging of the lumbosacral spine for an evaluation of the spread of LA. The patient was evaluated 30 minutes after the block. The patient reported complete relief of pain and reduced sensation to pinprick over the T11–L4 dermatomes ipsilateral to the site of block. Examination of the quadriceps muscle revealed an MRC scale score of 3.

Spinal anesthesia was the anesthetic of choice using 10 mg of 0.5% hyperbaric bupivacaine injected at the L3–4 interspace using a 25G spinal needle after preloading the patient with 1000 mL ringer's lactate solution. The patient

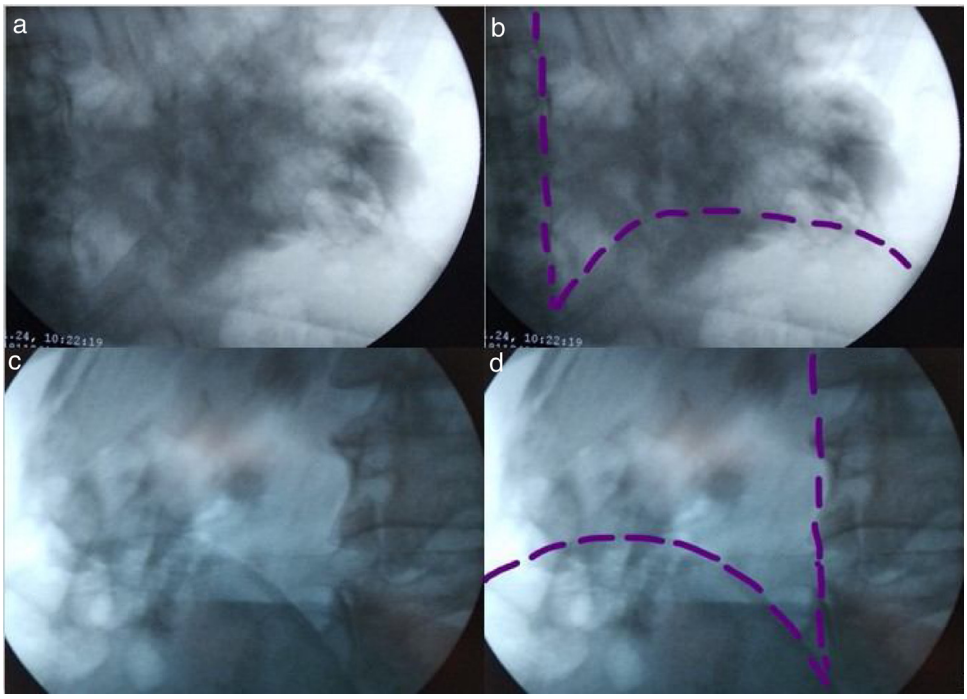

Figure 3 Frontal radiograph of the lumbo-sacral region to observe the pattern of contrast-LA mixture spread using C-Arm X-Ray Machine. (a and b) Left lumbo-sacral region in Case 3. (c and d) Right lumbo-sacral region in Case 4. The dark shadow represents the pattern of contrast-LA spread, purple dotted lines represent iliac crest and vertebral column borders.

was comfortably placed in the sitting position for spinal anesthesia to be done without pain. Postoperatively, the patient did not require any rescue analgesia for 24 hours and the MRC scale score was 5.

Discussion

To our knowledge, this is the first trial to evaluate a paraspinal sagittal approach of transmuscular QL block for hip surgery. Clinically with the examination of the sensory distribution of the block in the four patients studied, it was found to cover the area between the T11–12 and L4–5 dermatomes. Spread of the injectate was confirmed via an A–P fluoroscopy imaging of the lumbosacral spine after injection of a mixture of LA and a contrast in the plane between the QL and PM muscles (Fig. 3). The epimysium of the QL was pierced and LA was deposited anterior to the QL muscle in the plane between it and the psoas muscle, allowing its spread under the ATLF (fascia transversalis) at the level of L4. Fluoroscopic imaging confirmed the spread of LA in the course of the PM muscle towards the pelvis beyond the level of the fifth lumbar vertebra, with medial spread towards the lumbar nerve roots in the lumbar paravertebral region. When LA is deposited between the QL and PM muscles in the transmuscular QLB, there is a potential for medial spread to the ventral rami of L2 and L3 and possibly the obturator nerve, lateral spread to the lateral cutaneous nerve of the thigh, and caudal spread under the fascia iliaca, which is continuous with the fascia transversalis and hence the ATLF.[7] Accordingly, LA deposited between the PM and QL muscles may accomplish the role of both a transversus abdominis plane block and a lumbar plexus block.

The spread of injectate following different variants of QLB has been described in several studies. Adhikary et al. demonstrated consistent spread to the upper branches of the lumbar plexus after the injection of 20 mL of a contrast material in the transmuscular QLB plane at L4 in fresh cadavers.[8] In another cadaveric study, Carline et al. compared dye spread following the three different approaches of QLB. All cases of transmuscular QLB resulted in the spread of injectate to L1–L3 nerve roots. That was not the case with other QLB variants, where spread of the dye to the lumbar nerve roots was inconsistent.[9] One recent study by Sanjib D Adhikary et al., comparing TQL block versus lumbar plexus block for THA, concluded that TQL block provides similar analgesia to the lumbar plexus block following THA.[5]

At the level of L4, ATLF fuses with the psoas muscle fascia covering it antero-laterally. We emphasize piercing the QL epimysium, thus targeting a plane posterior to the ATLF, which is continuous laterally with the fascia transversalis and caudally with the fascia iliaca.[10]

This approach of the QL block may have several advantages. The endpoint of injection is a fascial plane rather than a specific motor response required during lumbar plexus stimulation, which allows easy identification with avoidance of the possible risks of nerve injury, inadvertent dural puncture and intrathecal spread of LA. LA is allowed to spread caudally, which may reach the plane under the fascia iliaca, with the PM muscle providing a protective barrier against accidental needle entry into the peritoneal cavity. Finally, when continuous analgesia is sought, insertion of a catheter is optimal in the long axis of QL and PM muscles. The technique in the four studied cases was easy, with clear identification of the muscle layers; however, due to lack of

experience or in obese patients, identification of the needle may be difficult and the risk of kidney injury is a possibility.

The limitations of the present study are that only four cases were included and that fluoroscopic imaging of the spread of the contrast has been carried out in two cases only; thus, results cannot be generalized. In addition, the study didn't examine whether or not the PSSS technique can be used for surgical anesthesia in hip surgery. A prospective randomized study is being carried out in our institution to compare the PSSS approach of the QL block with the lumbar plexus block in hip arthroplasty. Future cadaveric or human studies with magnetic resonance imaging of the spread of non-ionized contrast would be demonstrative of the spread of LA solution during the PSSS approach of QLB, as compared with the other approach. We concluded from the present study that the PSSS technique for TQL block may be beneficial as a part of multimodal analgesia for hip surgeries. This technique may be a safe alternative to psoas compartment block, however, future comparative studies are recommended. The PSSS technique for TQL block may also provide an easy access for catheter insertion.

Registry number

NCT03733769.

Funding

Self fund.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Bugada D, Bellini V, Lorini LF, et al. Update on selective regional analgesia for hip surgery patients. Anesthesiol Clin. 2018;36:403–15.
2. Dyck BA, Zywiel MG, Mahomed A, et al. Associations between patient expectations of joint arthroplasty surgery and pre- and post-operative clinical status. Expert Rev Med Devices. 2014;11:403–15.
3. Taha AM, Ghoneim MA-E. Hip hemiarthroplasty using major lower limb nerve blocks: a preliminary report of a case series. Saudi J Anaesth. 2014;8:355.
4. Ueshima H, Yoshiyama S, Otake H. The ultrasound-guided continuous transmuscular quadratus lumborum block is an effective analgesia for total hip arthroplasty. J Clin Anesth. 2016;31:35.
5. Adhikary S, Short A, El-Boghdadly K, et al. Transmuscular quadratus lumborum versus lumbar plexus block for total hip arthroplasty: a retrospective propensity score matched cohort study. J Anaesthesiol Clin Pharmacol. 2018;34:372–8.
6. Kleyweg R, Van der Meche F, Schmitz P. Interobserver agreement in the assessment of muscle strength and functional abilities in Guillain-Barre syndrome. Muscle Nerve. 1991;14:1103–9.
7. Willard F, Vleeming A, Schuenke M, et al. The thoracolumbar fascia: anatomy, function and clinical considerations. J Anat. 2012;221:507–36.
8. Adhikary S, El-Boghdadly K, Nasralah Z, et al. A radiologic and anatomic assessment of injectate spread following transmuscular quadratus lumborum block in cadavers. Anaesthesia. 2017;72:73–9.
9. Carline L, McLeod G, Lamb C. A cadaver study comparing spread of dye and nerve involvement after three different quadratus lumborum blocks. Br J Anaesth. 2016;117:387–94.
10. Rosario D, Jacob S, Luntley J, et al. Mechanism of femoral nerve palsy complicating percutaneous ilioinguinal field block. Br J Anaesth. 1997;78:314–6.