Original Article

Intricacies of Ultrasound-guided Lumbar Plexus Block in Octogenarians: A Retrospective Case Series

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Abstract

Background: Ultrasound (US)-guided lumbar plexus block (LPB) could be technically challenging in elderly patients. The lumbar paravertebral sonoanatomy is undescribed in the elderly. In an attempt to understand the relevant sonoanatomy, identify the lumbar plexus elements, and understand the difficulties that encountered while performing LPB in elderly patients, we retrospectively analyzed US of 23 elderly patients who were administered US-guided LPBs. **Methods:** After institutional ethics committee approval, we retrospectively reviewed stored US images of lumbar paravertebral sonoanatomy in 23 elderly patients and analyzed psoas major muscle, lumbar vertebral body, lumbar nerve, and lumbar artery. **Results:** On US examination, features of psoas major muscle, lumbar vertebral body, lumbar nerve, and lumbar artery were noted and analyzed. **Conclusion:** US-guided visualization of the components of the lumbar paravertebral area is difficult and inconsistent in the elderly. Therefore, we suggest performing a scout scan, identify the structures, and use neurostimulation all the time for performing LPB in these patients.

Keywords: Geriatrics, lumbosacral plexus, nerve block, regional anesthesia, ultrasonography

Introduction

Ultrasound (US) improves the safety and efficacy of plexus blocks with low volumes.[1] The needle to nerve contact and the local anesthetic (LA) spread are two important aspects of successful block, though neurostimulation during an US-guided block does not necessarily produce an evoked motor response.[2,3] The lumbar paravertebral sonoanatomy is well described in young adults with normal body mass index. The psoas major muscle, quadratus lumborum muscle, and erector spinae muscles were well identified from L2 to 5 levels, except the lumbar plexus elements.[4]

Literature search using relevant keywords (nerve block, ultrasonography, lumbosacral plexus, local anesthetic, and geriatrics) did not reveal any studies mentioning the lumbar paravertebral sonoanatomy in the elderly. Twenty-three elderly patients who were to undergo proximal femoral nail for a proximal femoral fracture were administered a lumbar and sacral plexus block as a primary anesthetic. In these cases, our aim was to understand the lumbar paravertebral sonoanatomy in the elderly, identify the lumbar plexus elements, and estimate the impracticability during the lumbar plexus block (LPB) in the elderly group of patients.

Unlike the previous studies performed exclusively in young adults, the components of lumbar paravertebral sonoanatomy (lateral vertebral border, psoas major muscle, and lumbar plexus elements) are not clearly visible in the elderly. The distorted lumbar paravertebral sonoanatomy in the elderly mandates a cautious approach with a neurostimulation to guide the needle tip during a US-guided LPB.

Materials and Methods

We retrospectively reviewed the medical records from January 2018 to January 2019 and gathered data from

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23 patients above the age of 80 years, who were classified as American Society of Anesthesiologists physical status III–IV. All patients had either two or three comorbidities in the form of cardiac, pulmonary, and renal disorders. Eight patients had undergone spine surgery with instrumentation. All patients underwent US-guided (shamrock method) and neurostimulation-aided LPB.[5] As hip is innervated by lumbar and sacral plexus, blocking the sacral plexus is mandatory to achieve unilateral surgical anesthesia. Therefore, US-guided and neurostimulation-aided sacral plexus block was supplemented in all patients.

An ethics committee approval was obtained for this retrospective study. (The IRB approval number is EC-SIOR/Agenda 060, dated 29th May 2020). Informed consent was obtained from all the patients who received the intervention. US scout scan was performed to understand the lumbar paravertebral sonoanatomy with the shamrock method. The following components of lumbar paravertebral sonoanatomy were identified: the bony components of the vertebra, namely the transverse process and the lateral vertebral border. The visibility of the transverse process and the contour of the lumbar vertebral body were appraised for its echogenicity. The psoas major muscle was assessed for its echogenicity. Attempts were made to visualize the lumbar nerve root in the inter-transverse plane (between the two transverse process) as the they emerged from the intervertebral foramina [Figure 1a].

Observations and Results

We analyzed the saved records of 23 elderly patients (mean age – 85.04 years, males – 10, females – 13). Structures identified on ultrasonography expressed in numbers and percentages are summarized in Table 1. The following features of psoas major muscle, lumbar vertebral body, lumbar nerve, and lumbar artery were noted and are discussed below.

The psoas major muscle was hypoechoic [Figure 1b] in 07/23 (30.4%) and hyperechoic [Figure 1c] in 16/23 (69.5%). In 12/23 (52.1%) patients, the lumbar vertebral body had lost its typical rounded appearance and was replaced with hyperechoic border [Figures 1d and 2a]. Of 11/23 (47.8%) patients, the lateral aspect of the vertebral body presented as hypoechoic borders [Figures 2a and 2d]. The lumbar nerve was identified in 4/23 (17.3%). The echogenicity of the lumbar nerve root was similar to the hyperechoic psoas major muscle [Figure 2c]. The lumbar artery was identified in 6/23 (26.1%) patients, close to the lateral vertebral body [Figure 2d].

Table 1: Structures identified on ultrasonography expressed in numbers and percentages

Structure identified on scan	Identified/total patients (%)
Nerve root identification rate	4/23 (17.3)
Lumbar artery identification rate	6/23 (26)
Vertebral body shape	
Hypoechoic and concave	11/23 (47.8)
Hyperechoic and convex	12/23 (52.1)
Psoas major muscle	
Hypoechoic	7/23 (30.4)
Hyperechoic	16/23 (69.5)

Discussion

The wedge-shaped area immediate lateral to the outer part of the intervertebral foramina which hosts the lumbar nerve root is the lumbar paravertebral space (LPVS). In this retrospective analysis of patients above 80 years old, the psoas major muscle was more hyperechoic with poor visibility of the lumbar plexus elements in the lumbar paravertebral area. Ultrasound of paravertebral sonoanatomy (lateral vertebral border, psoas major muscle, and lumbar plexus elements) were assessed for deformation of lateral vertebral border.

Studies claim that though the lumbar plexus elements were not visible in young adults, the needle could be positioned under US guidance close to the location of the lumbar plexus in the lumbar paravertebral area.[6] The lumbar paravertebral sonoanatomy is vividly described by three different US approaches. The first one is through the acoustic window of a lumbar trident.[7] The second is through the transverse scan named the "Shamrock technique" and the third one is the transverse scan through the lumbar intertransverse space (LITS).[5,8] All these approaches strive hard to demonstrate the lumbar plexus elements only in young adults and not the elderly.

In the acoustic window of lumbar trident, the psoas major muscle was visualized as multiple longitudinal hyperechoic striations against a hypoechoic background typical of muscle. The lumbar nerves were identified as hyperechoic structures in more than 50% of cases. In real time, the needle visibility was poor. Neurostimulation identified the lumbar plexus, and LA spread was observed in the psoas major muscle.[6] The Shamrock and the transverse scan through the LITS provided good imaging of the anatomy relevant for LPB including the erector spinae, psoas major muscle and quadratus lumborum muscles, lumbar nerve root, lumbar paravertebral space, and the lumbar plexus. In the transverse scan through LITS apart from the demonstration of lumbar paravertebral sonoanatomy, the needle-nerve contact was appreciated in 93% and the LA spread in 40% of cases.

In clinical practice, we encounter elderly patients with serious comorbidities for surgical corrections of intertrochanteric fracture. The LPB is the regional anesthesia technique of choice since it produces minimal sympathetic block and effective hemodynamic stability.

The musculoskeletal structures, particularly in the elderly (>60 years), can reduce the contrast between a peripheral nerve and its surrounding muscles and eventually affect the resolution of US images.[9] The echo intensity of muscle is significantly increased in the elderly. Echogenicity of muscle in the elderly is affected by diminished muscle composition due to an increase in

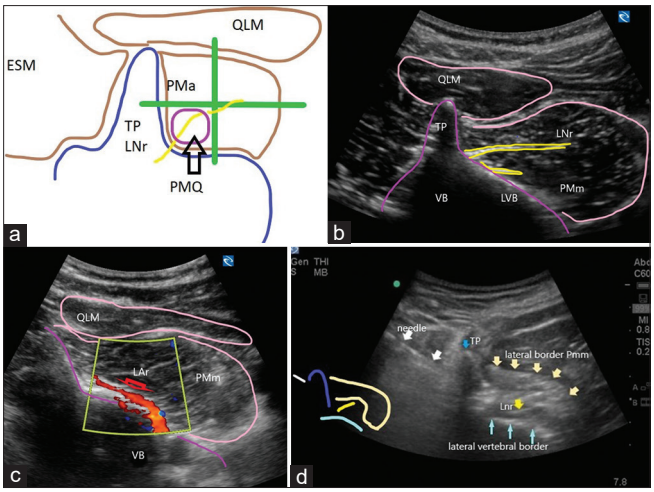

Figure 1: (a) Schematic representation of PMm and posteromedial quadrant (ESM: Erector spinae muscle, QLM: Quadratus lumborum muscle, PMm: Psoas Major, TP: Transverse process, Lnr: Lumbar nerve root, PMQ: Posterior-medial quadrant, Black arrow: Points toward PMQ [purple square]). (b) Lumbar paravertebral sonoanatomy; Lumbar nerve root (yellow) in patients aged 44 years. QLM: Quadratus lumborum muscle, TP: Transverse process, VB: Vertebral body, LVB: Lateral vertebral body, PMm: Psoas major muscle, LNr: Lumbar nerve root. (c) Lumbar paravertebral sonoanatomy; Lumbar vertebral artery in patients aged 44 years. QLM: Quadratus lumborum muscle, VB: Vertebral body, PMm: Psoas major muscle, LAr: Lumbar artery. (d) Lateral border of PMm (light yellow), Lateral vertebral body: Light blue arrows, TP: Dark blue arrow, Needle: White, Lnr: Dark yellow arrow

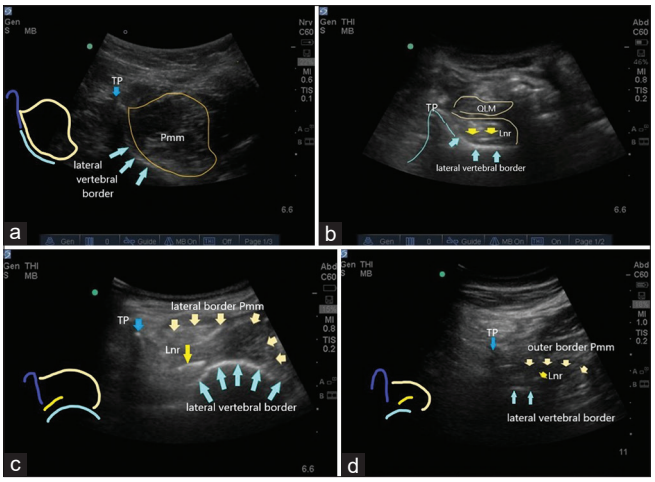

Figure 2: (a) Convex lateral border. Hyperechoic convex lateral vertebral body: Light blue arrows, TP: Dark blue arrow, PMm: Light yellow arrows, Needle: White. (b) Hypoechoic PMm: Light yellow, Lateral vertebral body: Light blue arrows, TP: Dark blue arrow, Lnr: Dark yellow. (c) Concave lateral border. Hypoechoic lateral vertebral body: Light blue arrows, TP: Dark blue arrow, PMm: Oval light yellow. (d) Lumbar hyperechoic nerve root. PMm: Light yellow arrows, Vertebral body: Light blue arrows, TP: Dark blue arrow, Needle: White, Lnr: Dark yellow arrow

the adipose tissue or fibrosis in the muscle.[10] The visibility of the hyperechoic needle will be impaired within the hyperechoic psoas major muscle (69.5% in our case series). Needle redirections would be required whenever needle insertion is beyond the transverse process and contacts the deformed lumbar vertebral body. The lumbar nerve root was identified in 4 out of 23 patients. The distorted lumbar paravertebral sonoanatomy secondary to the deformed lateral vertebral border that alters the topographical anatomy of the hyperechoic psoas major muscle harboring the hyperechoic lumbar nerve root would obviously pose a serious challenge to identify the hyperechoic needle to target the lumbar plexus elements in the elderly. Autopsy studies on large number of subjects have found disc degeneration, facet joint osteoarthritis, or osteophytes in 90%–100% of subjects aged over 64 years. Some signature patterns such as "trefoil-shaped canal" or pagetic vertebra have been described in the literature.[11]

The lumbar artery is lateral to the vertebral body, and the lumbar nerve is lateral to the lumbar artery. It is ideal to position the needle tip lateral to the lumbar nerve when performing a LPB. However, the lumbar artery was identified in only 26% of the patients, further complicating the LPB procedure.

This study describes the characteristic features of lumbar paravertebral sonoanatomy above 80 years of age. Several studies regarding the lumbar paravertebral sonoanatomy are in young adults in whom a LPB may be unwarranted. LPBs are indicated in elderly patients with comorbidities like for instance proximal femoral fractures mentioned in this article. It is of great importance to demonstrate the lumbar paravertebral sonoanatomy in elderly patients, since the anatomy of lumbar vertebral body, the psoas major muscle, and the topography of the lumbar paravertebral area hosting the lumbar nerve are altered when compared to young adults. A cautious needle approach with a continuous neurostimulation to guide the needle tip close to the lumbar plexus elements is mandatory. Ilfeld *et al*. recommended estimating depth of the transverse process with US and predicting the actual needle-to-plexus intercept depth for LPB. Based on our study in these elderly patients, we suggest a scout scan to understand the lumbar paravertebral area followed by a continuous neurostimulation to obtain a needle-nerve contact with careful maneuver of the needle tip in the lumbar paravertebral area.[12]

Conclusion

As opposed to lumbar paravertebral sonoanatomy in adults and children, the US image in patients above the age of 80 years is not appropriately visualized and is of poor quality. The skewed lateral vertebral border and the degenerative and atrophic psoas major muscle distort the lumbar paravertebral area which hosts the lumbar nerve. Visibility of the hyperechoic needle would be severely hampered in the hyperechoic psoas major muscle. We therefore recommend a thorough scout scan of the lumbar paravertebral area in the elderly, to obtain contact of the TP under US and maneuver needle tip in lumbar paravertebral area aided by neurostimulation.

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Conflicts of interest

There are no conflicts of interest.

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