Journal of Clinical Anesthesia 37 (2017) 82–85

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

Original contribution

# The use of ultrasound in planned cesarean delivery under spinal anesthesia for patients having nonprominent anatomic landmarks

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ARTICLE INFO

*Article history:*
Received 10 May 2016
Received in revised form 22 September 2016
Accepted 27 October 2016
Available online xxxx

*Keywords:*
Ultrasound
Vertebral column
Landmark
Spinal anesthesia

ABSTRACT

*Study objective:* The aim of the study was to compare conventional landmark method with ultrasound-guided spinal anesthesia in cesarean delivery cases where spinous processes and interspinous spaces were not prominent on physical examination.
*Design:* Randomized controlled clinical trial.
*Setting:* Operating rooms of university hospital of Erzurum, Turkey.
*Patients:* Sixty-four 18- to 45-year-old American Society of Anesthesiologists I-II patients scheduled for cesarean delivery under spinal anesthesia having hardly palpated anatomic landmarks on vertebral column.
*Interventions:* Palpation difficulty of vertebral column landmarks was scored as 0, 1, 2, or 3 from easy to difficult for all patients in sitting position. The patients with score 2 or 3 were randomly allocated into 2 groups as group C (conventional, n = 32) and group U (ultrasound, n = 32) in which ultrasound guidance was used.
*Measurements:* The number of skin punctures, the number of needle steering, the number of puncture tried vertebral levels, and procedure time were all recorded.
*Main results:* The number of skin punctures was significantly lower in group U ($P < .001$). Successful subarachnoid puncture on first attempt was also significantly higher in group U ($P < .01$). The duration of procedure in the patients with score 2 was determined to be significantly longer in the ultrasound-guided group ($P < .001$).
*Conclusions:* Ultrasound guidance is an effective and safe method to reduce the number of puncture attempts, improve the success rate of subarachnoid access on the first attempt, and reduce the need to puncture multiple levels, although it prolongs procedure time in patients with score 2 according to our scoring system designed for this current study.



## 1. Introduction

Regional and general anesthesia techniques are used for cesarean delivery. Neuroaxial block is the most commonly used method to avoid the complications of general anesthesia [1]. Despite the rapid increase in the number of cesarean deliveries, the low rate of anesthesia-related complications is due to common use of epidural and spinal anesthesia. The more widespread use of regional anesthesia, especially in Germany, Switzerland, the United States and the UK is supported by clinical guidelines and current publications [2,3]. Although the rate of major complications is known to be low in neuroaxial block, as

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http://dx.doi.org/10.1016/j.jclinane.2016.10.014
0952-8180/

palpation is difficult in pregnant patients, the determination of puncture site is more difficult, and thus, the risk of complications is increased [4].

Ultrasound (US) guidance for neuroaxial blocks is a simple, noninvasive, safe, quick, and risk-free method. It can be useful when the vertebral column anatomy has aberrations or variations [5]. The use of US in neuroaxial blocks is a new application and becomes more and more popular in recent years as image quality gets better in correlation with technological advance. US is used in determination of the skin puncture site, measurement of the epidural space, visualizing the orientation of the needle, and the spreading of the drug in spinal anesthesia [6]. There are limited data in the literature about US guidance for spinal injections.

The aim of the current study was to compare conventional landmark method with US-guided spinal anesthesia in cesarean delivery cases where spinous processes and interspinous spaces were not prominent on physical examination.

## 2. Patients and methods

Approval for the study was granted by the Erzurum Ataturk University Medical Faculty Ethics Committee. After obtained informed consents, American Society of Anesthesiologists I-II 18- to 45-year-old patients scheduled for cesarean delivery under spinal anesthesia were included in the study. Bleeding diathesis, refusal to the spinal anesthesia, use of medication disturbing bleeding profile, any finding of infection in puncture site, high intracranial pressure, severe stenotic heart disease or obstruction of the ventricular outlet, severe spinal deformity, and twin pregnancy were exclusion criteria.

Palpation difficulty of vertebral column landmarks was scored as 0, 1, 2, or 3 from easy to difficult for all patients in sitting position as follows:

Score 0: Spinous processes can be palpated, and the interspinous spaces are evident.
Score 1: Spinous processes can be palpated, and interspinous spaces are not evident.
Score 2: Spinous processes cannot be palpated, interspinous spaces are not evident, and vertebral column can be palpated on the midline or outside the midline,
Score 3: Spinous processes cannot be palpated, interspinous spaces are not evident, and vertebral column cannot be palpated.

A total of 64 patients with score 2 or score 3 were included in the study. These patients were randomly allocated into 2 groups as group C (conventional, n = 32) and group U (US, n = 32) by closed envelope method. The procedures were performed by 2 physicians who were experienced about spinal anesthesia and US-guided spinal intervention.

Noninvasive arterial blood pressure, electrocardiogram, and pulse oxymetry were used for routine hemodynamic monitoring of all patients in operating room. The basal values before spinal anesthesia were recorded and 10 cc/kg colloid was administered to all patients via intravenous route.

Esaote MyLab 30 (Florence, Italy) US device with a 3.5-mHz frequency convex probe was used for imaging intervention area in group U. A line in the horizontal plane joining the uppermost points of both iliac crests (Tuffier line) was drawn in sitting position. L2-L3, L3-L4, and L4-L5 interspinous spaces were determined with longitudinal paramedian sagittal plane imaging starting from the sacrum the region as far as the Tuffier line and L3-L4 was marked with a horizontal line (Fig. 1). By imaging the same area in the transverse plane, L2, L3, and L4 spinous processes are determined and joined with a vertical line (Fig. 2). The puncture site was defined as the point where horizontal and vertical lines crossed each other. After providing aseptic technique conditions, infiltration anesthesia was applied with 2% lidocaine (Aritmal 2.5% mL ampule, 100 mg; Osel Pharmaceutical Industry, Istanbul, Turkey). A 27-gauge spinal needle was then proceeded to subarachnoid space through its needle guide which passed through skin and subcutaneous tissue.

In the group C patients, the L3-L4 interspinous space was determined by drawing a horizontal line (Tuffier line) joining the uppermost points of both iliac crests in sitting position. In pregnancy, forward rotation of the pelvis causes the line connecting the iliac crests to cross the spine at a higher level (L3-L4) and L1 spinosus process is determined by a line meeting the costal margin 10 cm from the midline. Upper and lower spinous processes were determined between L1 and L4. The upper and lower spinous processes were marked with a skin pen and a joining vertical line was drawn. The puncture was performed with a 27G spinal needle through its needle guide where horizontal and vertical lines crossed each other after providing aseptic technique conditions and infiltration anesthesia with 2% lidocaine.

The number of skin punctures, the number of needle steering, the number of puncture tried vertebral levels, procedure time, and any subsequent complications were recorded for both groups.

Success on a single-puncture attempt was defined as reaching the subarachnoid space on the first insertion of the needle without any withdrawal from the skin.

Success on a single-needle steering was defined as reaching the subarachnoid space with a single-needle orientation on the first puncture.

A timer was used to measure the procedure time from the start of US imaging to visualization of CSF flow in group U and from the first hand contact to the skin to visualization of CSF flow in group C.

### 2.1. Statistical analysis

The main aim of this study was to compare the number of puncture attempts and the procedure time among the groups. In a prestudy, the numerical difference in puncture attempts among the groups was determined to be at least 1 and the approximate SD was calculated to be 0.50 in the US group and 0.90 in the conventional group. Assuming the $\alpha$ and $\beta$ error as 0.5 and 0.10, respectively, and accepting intergroup

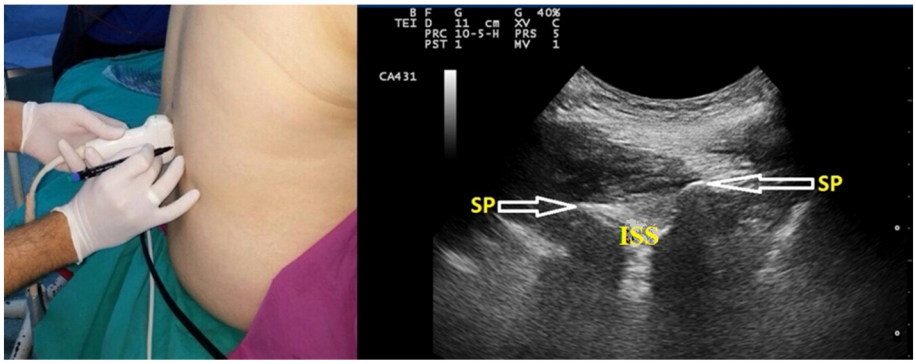


**Fig. 1.** Lumbar sagittal sonogram, spinous process (SP), and interspinous space (ISS).