Ultrasound-guided Lumbar Puncture

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Evidence

- Nomura, Jason T. et al. A randomized controlled trial of ultrasound-assisted lumbar puncture. Journal of Ultrasound. Oct 1 2007, 1341-1348.
  - *Small randomized, controlled double-blinded study*
    Results: 6 of 22 failed with PLs, 1 of 24 failed with US. In 12 obese patients, 4 of 7 failed with PL's, 0 of 5 failed with US.

    Conclusions: The **use of ultrasound for LP significantly reduced the number of failures in all patients and improved the ease of the procedure in obese patients**.

Table Summary of randomized trials and meta-analyses of ultrasound guidance for lumbar puncture

Reference no.	Study type	Study population		Rate of successful procedure			Mean no. of attempts[a] (success on first pass, %)			Additional findings
		No.	Population	US	No US	*p* Value	US	No US	*p* Value	
9	RCT	66	ED patients needing LP	—	—	NS	—	—	—	Decreased procedure time
10	RCT	46	ED patients needing LP	95%	73%	<0.05	2	2	NS	Increased ease of procedure in obese patients
11	RCT	61	ED patients needing LP	97%	71%	0.07	1.6 ± 1.1 (97%)	2.3 ± 1.8 (71%)	0.66 (0.07)	Fewer failed procedures in elderly patients
12	RCT	60	ED patients age >60 y needing LP	100%	83%	<0.05	1.5 ± 0.8	3.3 ± 2.4	<0.05	Decreased procedure time; decreased pain scores; fewer traumatic taps
13	RCT	80	ED patients needing LP, ages 18-60 y	100%	100%	1	1 ± 0.5	2 ± 1	<0.047	Decreased procedure time; fewer traumatic taps; decreased pain scores
14	RCT	78	ED patients needing LP	—	—	—	1 (0-2)	2 (1-3)	0.57	Fewer traumatic taps
15	RCT	100	ED patients needing LP	78%	76%	0.81	3 (1-5)	5 (1-10)	0.24	
16[b]	Meta	1,334	14 RCTs	Risk ratio 0.21[c] (95% CI 0.10-0.43)		<0.001	Mean difference −0.44 (95% CI −0.64 to −0.24)		<0.001	Fewer traumatic taps; fewer needle redirections[d]
17[b]	Meta	1,678	13 RCTs	Risk ratio 0.51[c] (95% CI 0.32-0.80)		0.003	Mean difference −0.75 (95% CI −1.07 to −0.44)		<0.00001	Fewer traumatic taps

Abbreviations: CI = confidence interval; ED = emergency department; LP = lumbar puncture; meta = meta-analysis; NS = not significant; RCT = randomized controlled trial; US = ultrasound.

[a] Refers to withdrawing the needle completely out of the skin and then reinserting.

[b] Contains studies with both LPs and epidural anesthesia.

[c] Risk of failed LP or epidural anesthesia procedure (risk ratio <1 favors US; risk ratio >1 favors non-US).

[d] Refers to withdrawing needle back without completely removing it from body prior to reinsertion.

Source: Soni NJ et al. *Ultrasound guidance for lumbar puncture.* Neurology Clinical Practice. August 2016.

Technique

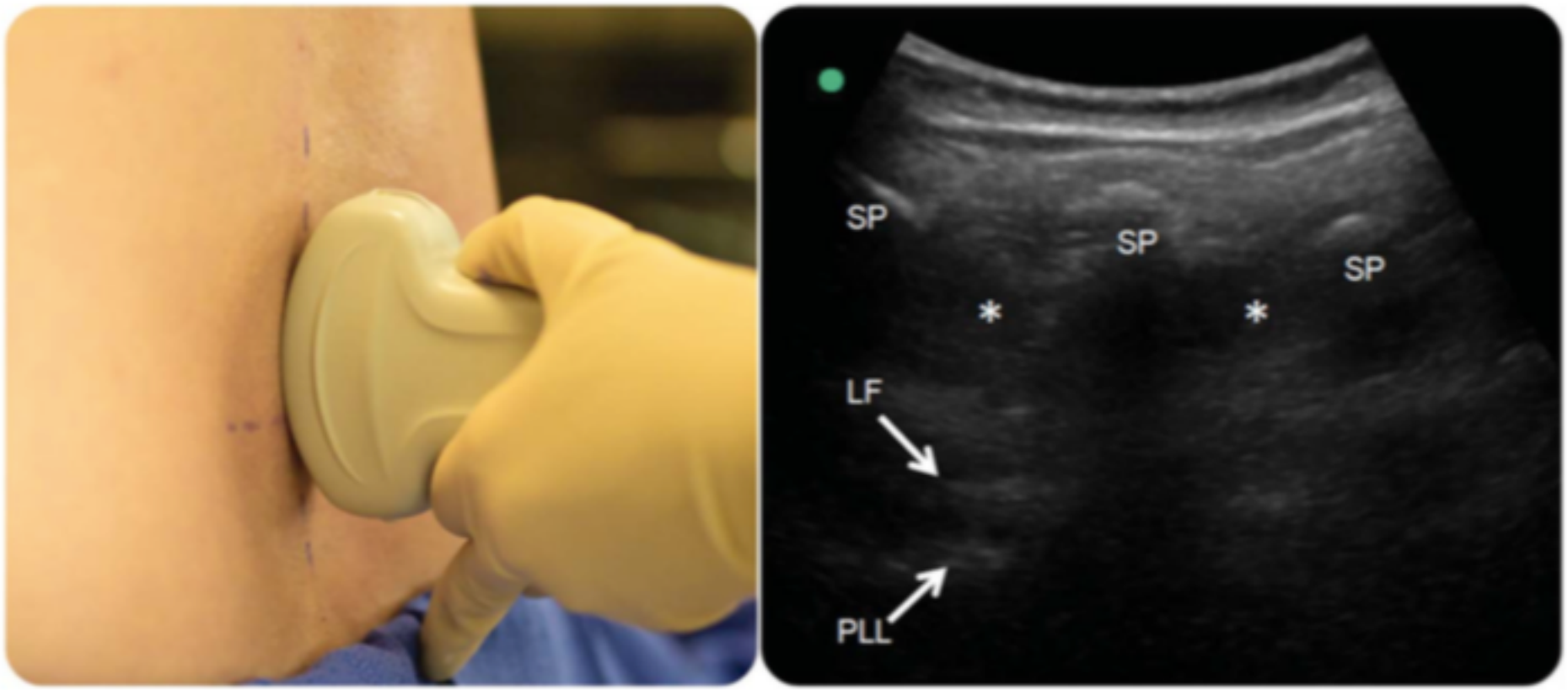
- Ultrasound-guided vs. ultrasound assisted in real time
- A general approach as follows:
  - Curvilinear probe for obese patients, linear probe for thin or pediatric patients
  - 1. Palpate both superior iliac spines. Draw imaginary line to connect them.
    2. Identify L3-4 or L4-5 space.
    3. Place probe in short axis. Identify spinous process.
    4. Mark skin above and below probe to indicate midline.
    5. Identify spinous processes above and below the proposed puncture site.
    6. Rotate probe to long axis.
    7. Center the interspinous process. Mark it.
    8. Measure distance to ligamentum flavum.

Images

Figure 2 **Transverse midline view**

A lumbar spinous process is centered on the screen with the transducer in a transverse plane, and a mark is made perpendicular to the transducer. Sliding the transducer along the midline allows visualization of the spinous processes (SP), lamina (L), posterior longitudinal ligament (PLL), and ligamentum flavum (LF).

Figure 3 Longitudinal midline view



The transducer is centered over a lumbar interspinous space in a longitudinal plane, and a mark is made perpendicular to the center of the transducer. The spinous processes (SP) and interspinous spaces (*) are visualized in a longitudinal plane, and the ligamentum flavum (LF) and posterior longitudinal ligament (PLL) are visualized deep to the spinous processes.

Take-home points

- Ultrasound-guided lumbar puncture improves success rates for lumbar puncture based on multiple RCTs, may decrease time of the procedure, and may reduce complications such as traumatic taps and needle redirections.
- Consider using ultrasound guided lumbar puncture in patients with difficult anatomy (secondary to obesity, scoliosis, etc.)
- Ultrasound can be used to map spinal anatomy prior to procedure or can be used for real-time guidance using a paramedian approach