

**ACCURACY OF TRANSFORAMINAL LUMBAR 5 EPIDURAL INJECTION BY
ULTRASOUND GUIDANCE CONFIRMED BY FLUOROSCOPE AND DYE INJECTION****Dr. Aya Raad Salman Abu Altemen^{*1}, Prof. Iyad Abbas Salman², Dr. Hala Baqir Kadum Al-Saedi³**¹MBCHB, Ficms, Specialist of Anesthesia & Intensive Care, Abu-Gharib General Hospital, Baghdad, Iraq.²MBCHB, Ficms, CABA&IC, FIPP, Chairman of the Scientific Council of Anesthesia and Intensive Care.³MBCHB, Ficms, Specialist of Anesthesia & Intensive Care, Nursing Home Hospital, Medical City, Baghdad, Iraq.***Corresponding Author: Dr. Aya Raad Salman Abu Altemen**

MBCHB, Ficms, Specialist of Anesthesia & Intensive Care, Abu-Gharib General Hospital, Baghdad, Iraq.

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ABSTRACT

Background: Transforaminal epidural injection of lumbar vertebrae 5 is the agreeable procedure for the treatment of lumbar radicular pain. The process is under Fluoroscopic guidance to ensure delicate needle positioning and to exclude intravascular injection but the negative point was exposure to radiation and the need to wear heavy lead apron. Ultrasound technique is considered to be low risk intervention and help to identify soft tissue target without radiation so the US guidance is thought to be an attractive alternative to fluoroscopy. **Aim:** The aim of study was to determine the accuracy of needle tip under ultrasound guidance thereafter confirmed with fluoroscopy in patient who is subjected to transforaminal nerve root injection. **Patient and Method:** A total of 20 patients with lumbar vertebrae 5 disc prolapse and radiculopathy referring to department of pain whose diagnosis were previously confirmed by Magnetic resonance imaging and were selected to undergo lumbar transforaminal epidural injection. The ultrasound guidance was used to perform transforaminal epidural injection. A needle was placed under the guidance of ultrasound and then confirmed with fluoroscope for dye spread. **Results:** The successful rate of ultrasound guided interventions was 95%(19) of 20 patient as confirmed by fluoroscopy and there was only one failed case in the ultrasound guided. There was significant association between ultrasound approach success and the fluoroscopy and there was significant positive correlation between ultrasound approach trials and number of fluoroscopy images. Ultrasound trials were significantly higher in failed ultrasound approach and in patients weighed 60-79kg. The number of images required in ultrasound approach was significantly lower than the number of images required in fluoroscopy approach. **Conclusion:** Ultrasound guided lumbar transforaminal epidural injections are accurate and practical in clinical cases with successful rate of 95%, ultrasound guidance has decreased radiation exposure and decreased need of operative room to significant level in this study.

KEYWORDS: Low Back Pain, transforaminal injection, ultrasound guidance, fluoroscopic confirmation, Radiculopathy.

INTRODUCTION

Low back pain is defined as lumbar spinal pain or sacral spinal pain or any combination of two.^[1] Low back pain is also defined as pain and discomfort, localized below the costal margin and above the inferior gluteal folds, with or without leg pain.^[2] Lower back pain can be classified depending on the duration into: Acute low back pain : low back pain persisting for less than 6 weeks, Sub-acute low back pain : low back pain persisting between 6 and 12 weeks, Chronic low back pain : low back pain persisting for 12 weeks or more. Lower back pain need not be restricted to lumbar and

sacral regions. Pain can be referred to other regions, most commonly lower limbs.

The Referred pain is pain perceived in a region innervated by nerves other than the nerves that innervate the actual source of pain.^[3] The upper lumbar facet joint may be referred to flanks, hip and lateral thigh, whereas pain from the lower lumbar facet joints is referred to posterior thigh. Facet joint pain is rarely referred below knees.^[4] Similarly pain from sacroiliac joint may be referred to lower lumbar region, abdomen, lower limbs and rarely to the foot.^[5]

Patients with degenerative disc disease (not disc prolapse) have axial back pain which can be referred to anterior thigh (L4-L5 disc) and posterior thigh (L5-S1).^[6] Radicular pain due to nerve root irritation caused by herniated disc causes pain radiating along a narrow band which follows a dermatomal pattern (segment of the skin supplied by a single particular nerve root).^[7]

Same rule applies to the pain caused by herpes zoster. Pain due to entrapment neuropathies follows the distribution of the affected nerves. For example, pain in meralgia paresthetica is seen in distribution of lateral femoral cutaneous nerve (anterolateral aspect of thigh).^[8]

AIM OF THE STUDY

To determine the accuracy of needle tip placement under US guidance thereafter confirmed with fluoroscopy in patient who subject to transforaminal nerve root injection.

PATIENT AND METHODS

This cross-sectional study was conducted on (20) patients in the pain management unit of Baghdad medical city from (1-January 2020) till (12-December 2020). Study population were all patients with low back pain causing radiculopathy referring to department of pain whose diagnosis were previously confirmed by MRI and were selected to undergo lumbar transforaminal epidural injection. Study protocol was reviewed and approved by institutional review Iraqi board of medical city.

Approval was obtained from Iraqi committee for medical specialization as well as written informed consent from all patients.

Inclusion criteria

- Patient with back pain radiated to lower limb (radicular pain) failed to response to conservative treatment of prolapsed disc.
- The age of the patients selected were from 40-70 years from both sexes.
- Weight 75-100 kg and height 160-180 cm.
- The American society of anesthesiology (ASA score I and II).

Exclusion criteria

- Patient refusal.
- Infection at the site of injection.
- Coagulated disorder.
- History of allergy to local anesthetic agent.
- Previous spinal surgery or deformity.

All the patients were assessed with detailed history taking and physical examination, we obtained IV access through peripheral IV cannula to all patients, and all the patients were monitored for the following parameters (BP, PR, SPO₂). The patient was placed in the prone position; a pillow is put under the abdomen to reduce

lumbar lordosis. A 3-8 MHz curvilinear US probe is utilized to perform the procedure.

Following the sterile technique, the US transducer was inserted in sterile coating and sterile US gel was applied on the patient sterile skin. A 22-Gauge, echogenic spinal needle was applied for all injections.

Starting at the sacrum, longitudinal scanning begins with the transducer positioned at the midline (Fig 1). Skin marking can be done with a pen alongside the transducer to support localize spinal levels and provide "reference points" of anatomic structures. Once the longitudinal midline images are obtained, the transducer is gently moved laterally until "a saw tooth" "hypoechoic line is seen (Fig 2). This bony structure explain the superior and inferior articular processes, these are the transverse processes with hypoechoic soft tissue between them (Fig 3).

Axial (short -axis) sonography is applied at the sacrum. The first distinct midline bony protuberance is the S1 median crest of the sacrum (Fig 4).

The transducer is moved cephalad until a deep hyperechoic structure is seen. This normally represents to the L5/S1 intrathecal space (Fig 5). If the ala of ileum in the path of needle we must move obliquely (the medial part of probe shifted caudally).

Next midline hyperechoic signal, cephalad to the intrathecal space, is the L5 spinous process. At any lumbar level, two axial views can be obtained : the interlaminar window (Fig 5) and the "spinous process/lamina window" (Fig 6). It is continue cephalad scanning and identify all lumbar spinous processes and correlate those with previously performed skin marking. When the transducer is firmly positioned at the desired level, a three -step shadow of the lumbar vertebra will appear. The most superficial hyperechoic structure: is the interspinous ligament or the spinous process, with the zygapophysial joint positioned just inferiorly and lateral to it and the transverse process located further inferiorly and laterally (Fig 7). The spinal needle was inserted just lateral to the US probe and inserted at the optimal site.

The fluoroscopy was taking in AP and lateral view to confirm the success of correct position of tip of needle (the needle should be lateral between 2 pedicle) and dye was injected to confirm that there is no intravascular or intrathecal spread and to show the dye spread in epidural space or to show the anatomy of nerve in AP and lateral view under fluoroscopy guidance. If successful so proceed the procedure if not may need simple manipulation either under the guidance of US, if under US regarded US as a second trial, if not successful so third trial by US was done for the patient.

In case of failure, reposition of needle was done by the guidance of fluoroscopy.

The main outcome of the study was to assess the accuracy of US in needle position under the guide of US in transforaminal area.

Accuracy of spinal segment integrity and pattern of radiopaque contrast spread were determined.

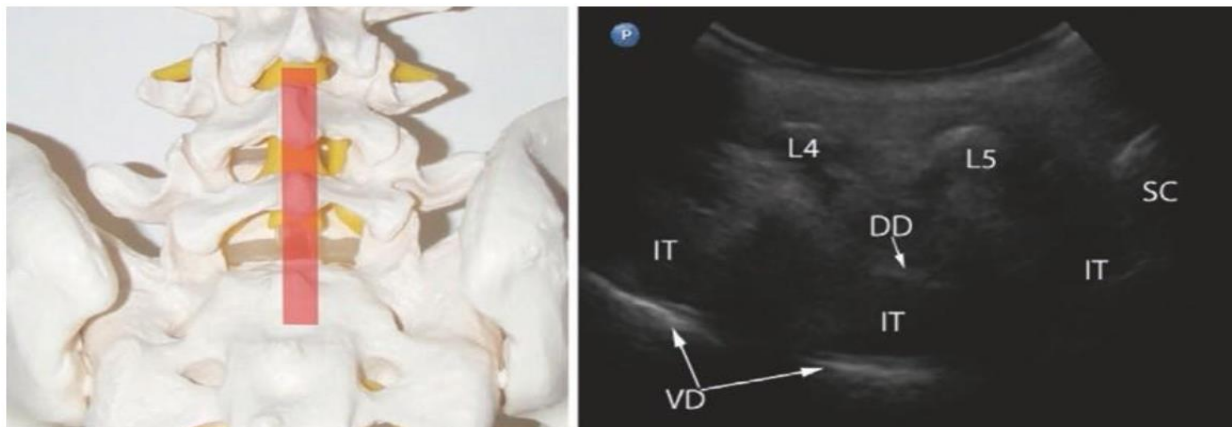


Figure 1: Left: midline position of the transducer (semitransparent red rectangle). Right: sonographic long axis view of the lumbar spine showing the L4(L4) and L5(L5) spinous processes, the median S1 crest(SC), the hyperechoic lines of dorsal (DD) and ventral dura (VD), and the hypoechoic intrathecal (IT) space.

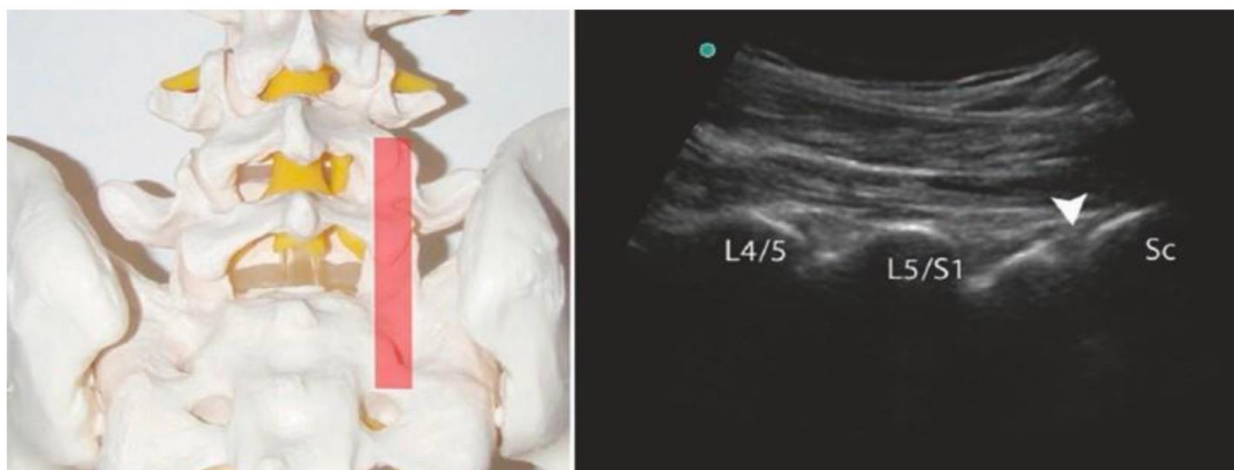


Figure 2: Left: paramedian position of the transducer (semitransparent red rectangle). Right: sonographic long axis view of the lumbar spine with the L4/L5(L4/L5) and L5/S1(L5/S1) zygapophysial joint contours and the S1 (arrowhead) dorsal foramen. The joint gap is not visible in this view.

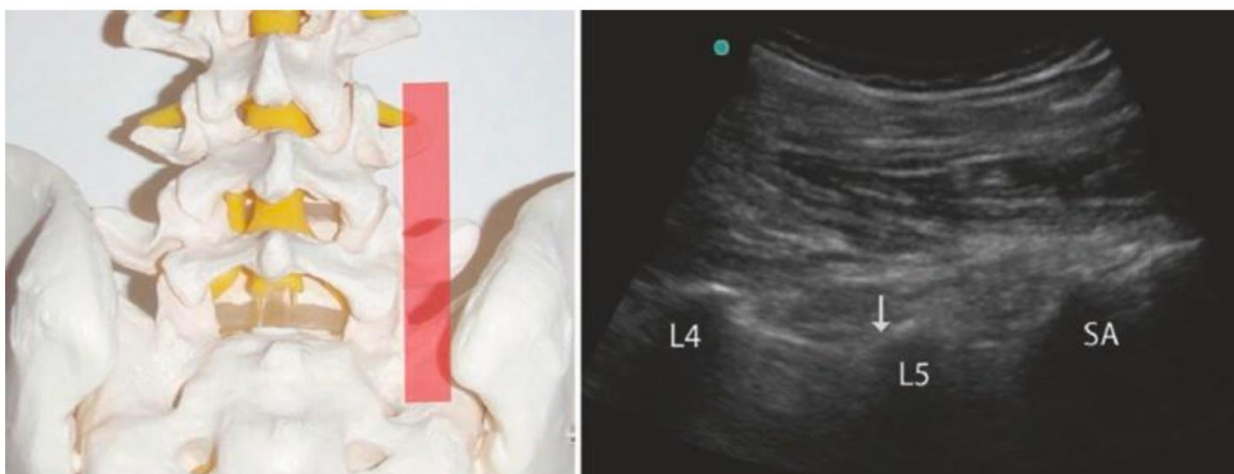


Figure 3: Left: lateral position of the transducer (semitransparent red rectangle). Right: sonographic long axis view showing the L4(L4) and L5(L5) and the sacral ala(SA). Upper edge of the transverse process or the sacral ala, immediately lateral to the superior articular process (arrow) is the correct anatomical target.

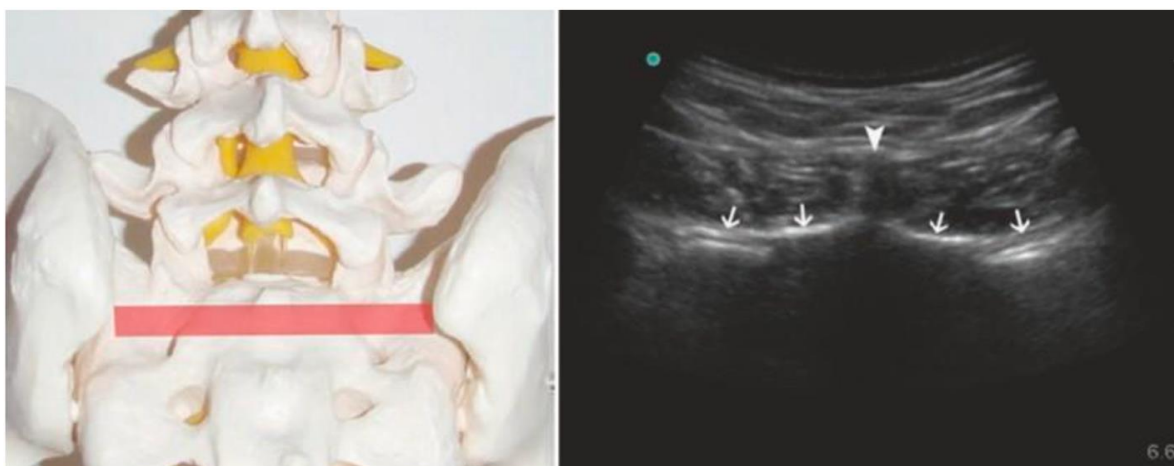


Figure 4: Left: axial position of the transducer (semitransparent red rectangle). Right: sonographic short –axis view of the sacrum showing the S1 median crest (arrowhead) and the hyperechoic surface (arrows) of the sacrum.



Figure 5: Left: axial position of the transducer (semitransparent red rectangle). Right: sonographic short –axis view of the lumbosacral segment showing the hypoechoic L5/S1 interspinous ligament (ISL), the L5/S1 zygapophysial joints (curved arrows), the intrathecal (IT) space, the S1 superior articular process (SAP), the sacral ala (SA), and the iliac crest (IC).

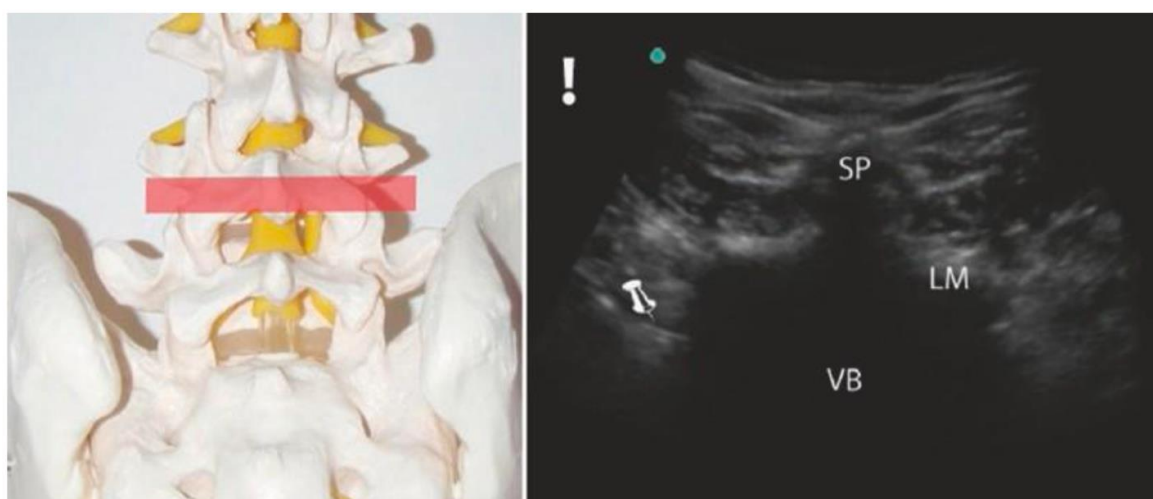


Figure 6: Left: axial position of the transducer (semitransparent red rectangle). Right: sonographic short –axis view of the L4 –vertebra (bone window). L4(SP) spinous process and L4 lamina (LM) are completely shadowing the L4 vertebral body (VB). Intrathecal space and the transverse process are not visible at this view. Exiting L4 nerve root is seen on the left (pin arrow).

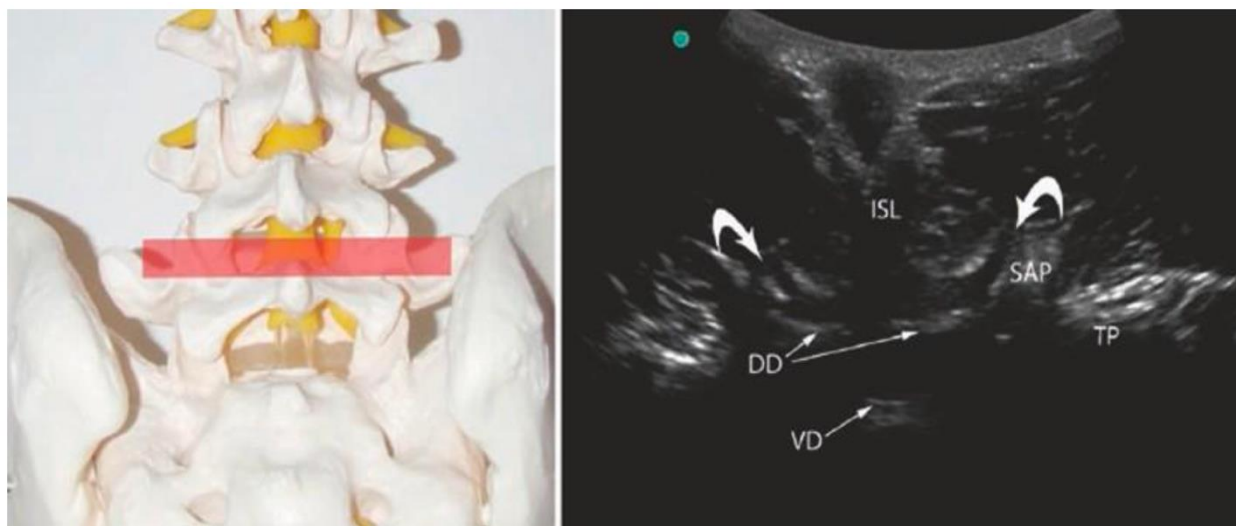


Figure 7: Left: axial position of the transducer (semitransparent red rectangle). Right: sonographic short-axis view of the L4/L5 segment showing the hypoechoic L4/L5 interspinous ligament (ISL), the L4/L5 zygapophysial joints (curved arrows), the dorsal (DD) and ventral dura (VD), the L5 SAP, and the L4 transverse process (TP).

IBM SPSS version 26 was used for this study statistical analysis. Participant characteristic data are presented as mean, SD and percentages. Chi-square test was used to test association between study group characteristics (P-Value = 0.05). Fisher exact test was used to test the association between U/S and fluoroscopy approaches (P-Value = 0.05). One sample t test was used to compare U/S approach number of images mean with the minimum image requirement for fluoroscopy approach (12 images); null hypothesis (no significant difference between U/S approach number of image required and fluoroscopy approach number of image required), alternative hypothesis (there is significant difference between U/S approach number of image required and fluoroscopy approach number of image required) (P-Value = 0.05). Independent samples t-test were used to assess the mean difference among general characteristics factors (P-value = 0.05). One way ANOVA test was used to assess the mean difference among general characteristics factors (P-value = 0.05). Pearson's correlation was used to assess the correlations between U/S trials, number of fluoroscopy images ($R \geq \pm 0.3$ P value = 0.05).

RESULTS

The description of the study group characteristics (table 1).

Table 1: Description of the study group characteristics.

Parameter	Mean $\pm$ SD	Minimum - Maximum
Age	49.25 $\pm$ 11	32 – 70
Weight	85.95 $\pm$ 7.63	75 – 100
Height	168.2 $\pm$ 7.13	160 – 180
BMI	30.73 $\pm$ 1.91	27.78 -35.16
U/S trials	1.25 $\pm$ 0.64	1 – 3
No. of Images	3.65 $\pm$ 2.25	2 - 12

- Age: the mean age of the study group was 49.25 $\pm$ 11.00 years.
- Gender: male to female percent was 50: 50 percent.
- Weight: the mean weight of the patients was 86.95 $\pm$ 7.63 kg.
- Height: the mean height of the patients was 168.2 $\pm$ 7.13 cm.
- Body mass index: the mean BMI of the study group was 30.73 $\pm$ 1.9 kg/m².
- Ultrasound approach trials: the mean of the U/s Approach trial was 1.25 $\pm$ 0.64 trials.
- Number of fluoroscopy images: the mean of fluoroscopy images was 3.65 $\pm$ 2.25 images.
- Difficulty of U/S approach: the proportions of difficult and non-difficult cases were 30% and 70% respectively.
- Ultrasound Approach: 95% of the U/S approach was eventually successful and only 5% failed as shown in table 2.
- Fluoroscopy Approach: the fluoroscopy procedure steps (AP Fluoroscopy, AP dye, Lateral view fluoroscopy and Lateral view dye) were successful in confirming the success of 95% of the U/S approach as shown in table 2.

Table 2: number of successful and failed cases with U/S.

	U/S Approach		p-Value
	Successful	Failed	
Collectively succeeded U/S approach confirmed by fluoroscopy	19 (95%)	1 (5%)	0.001

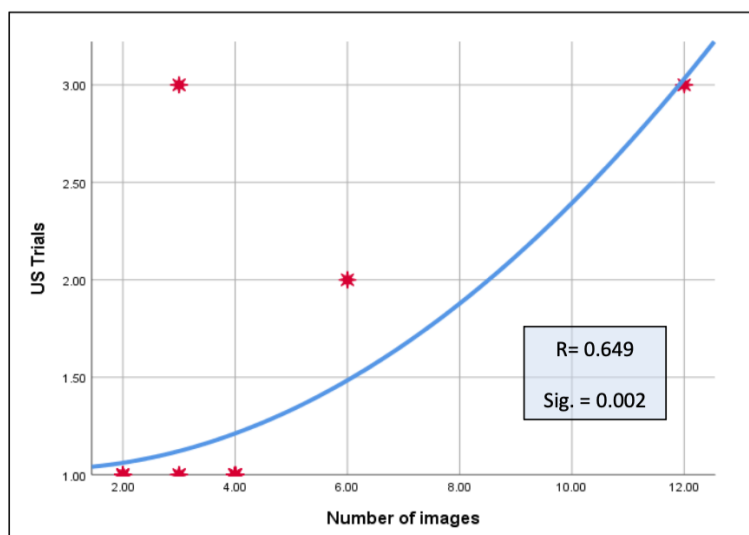
There was significant association between U/S approach success and the fluoroscopy steps confirming success (P-Value = 0.001) as shown in table 3.

There was significant positive correlation between U/S approach trials and number of fluoroscopy images ($R=0.649$, $P=0.002$) as illustrated in figure 8.

Table 3: Association between U/S approach success and the fluoroscopy steps confirming success.

	U/S approach		p-Value
	Failed	Successful	
AP Fluoroscopy	1	19	0.001*
AP Dye	1	19	0.001*
Lateral view fluoroscopy	1	19	0.001*
Lateral view dye	1	19	0.001*

*: Fisher exact significant P-Value <0.05.


Figure 8: Pearson correlations between U/S approach trials and number of fluoroscopy Images.

Difference in U/S approach trials among certain study group characteristics Described in (table 4).

- U/S approach: U/S trials were significantly higher in failed U/S approach (mean 3, P-Value = 0.002).
- Gender: no significant difference of U/S trials mean between male and female (P-Value = 0.736).
- Age group: no significant difference of U/S trials mean between different age groups (P-Value = 0.901).
- Weight group: U/S trials mean were significantly higher in 60-79 kg patient (P-Value = 0.002).

Table 4: Difference in U/S approach trials among certain study group Characteristics.

		U/S Trial Mean	p-Value
U/S approach	Failed	3	0.002*
	Success	1.16	
Sex	Male	1.3	0.736
	Female	1.2	
Age group (years)	30-49	1.3	0.901
	50-69	1.22	
	> 70	1	
Weight group (kg)	60-79	3	0.002*
	80-100	1.157	

*: Significant p-Value <0.05

Association of U/S approach difficulty and certain study group characteristics Described in (table 5).

- U/S approach: no significant Association between U/S difficulty and U/S approach success (P-Value = 0.502).
- Gender: no significant Association between U/S difficulty and gender (P-Value = 0.051)

- Age group: no significant Association between U/S difficulty and different age groups (P-Value = 0.788).
- Weight group: no significant Association between U/S difficulty and different weight groups (P-Value = 0.117).

Table 5: Association between U/S approach difficulty and certain study group characteristics.

		Difficulty		p-Value
		Yes (count)	No (count)	
U/S approach	Failed	0	1	0.502
	Successful	6	13	
	Total	6	14	
Sex	Male	5	5	0.051
	Female	1	9	
	Total	6	14	
Age group (years)	30-49	3	7	0.788
	50-69	3	6	
	> 70	0	1	
	Total	6	14	
Weight group (kg)	60-79	1	0	0.117
	80-100	5	14	
	Total	6	14	

Difference of number of images mean between U/S approach and fluoroscopy approach and study group characteristics, described in (table 6).

- The number of images (mean =3.65) required in U/S approach was significantly lower than the number of images required in the fluoroscopy approach (minimum 12 images) with (P-Value = 0.001).
- Gender: there was no significant difference in mean of images between male and female (P-Value = 0.09).

- Age group: there was no significant difference in mean of images between different age groups (P-Value =0.213).
- Weight group: there was no significant difference in mean of images with different weight group (P-Value = 0.776).

Table 6: Difference of number of images mean between U/S approach and 12 images as a minimal number of fluoroscopy approach and study group characteristics.

		Mean	p-Value
U/S approach number of images mean		3.65	0.001
Sex	Male	4.5	0.09
	Female	2.8	
Age group (years)	30-49	4.5	0.213
	50-69	2.67	
	> 70	4	
Weight group (kg)	60-79	3	0.776
	80-100	3.68	

DISCUSSION

Our study showed the accuracy of transforaminal lumbar L5 epidural injection is useful in both diagnosis and treatment of lumbar radicular pain.^[9] Our study is done under US and confirmed by fluoroscopy guidance for confirmation of needle tip position through contrast and to exclude intravascular injection but the disadvantage of fluoroscopy is the risk of radiation exposure, time consuming and the technique, while US has significantly increase because of elimination of radiation exposure, visualization of soft tissue, nerve, blood vessel, real time

needle advancement and insertion of needle tip in the target position in a few second. A number of reports showed that US guidance in lumbar spinal procedure is a possible but difficult technique.^[10] In spite of the spinal bony anatomical detection of lumbar region is unwell detected by US, under the low frequency of US probe, it feasible to detect lumbar spinal anatomy.

Our study showed that the mean age of 20 patients was 49.25±11 (32-70)years old and the mean weight of them was 86.95±7.63 (75-100)kg and the mean height was

168.20±7.13 (160-180)cm. 10 of patient was female (50%) and 10 of them was male (50%). The mean of BMI was 30.73±1.9 kg m and the mean of US trial was 1.25±0.64. The mean of fluoroscopic images was 3.65 ±2.25images. The proportions of difficult and non-difficult cases were 30% and 70% respectively. Our study showed that the collectively succeeded US approach confirmed by fluoroscopy was 95% of (19)cases and only 5%(1) was failed. The fluoroscopic procedure steps(AP fluoroscopy, AP dye, lateral view dye) were successful in confirming the success of 95% of the US approach. Our study showed that there was significant association between US approach success and the fluoroscopy steps confirming success(p-value 0.001) and there was significant association between US approach trials and number of fluoroscopy images p-value 0.002. US trials were significantly higher in failed US approach mean 3 p-value 0.002 but there was no significant difference of US trials mean in gender, age with p- value 0.736, 0.901 respectively but US trials mean were significantly higher in 60-79kg p-value 0.002. there was no significant association between US difficulty and US approach success, gender, different age group and weight with p-value =0.502, 0.051,0.788and 0.117 respectively. The number of images that needed in US approach was significant minimal than that needed in fluoroscopy approach (at least 12 images) with p- value 0.001 so it is benefit to decrease time exposure of radiation but there was no significant difference in mean of images in gender, age and weight.

In this study, we can localize transforaminal space in 95%(19) cases and only 5%(1) case was failure to transforaminal space(lower no. of failure) when compared with Dinesh Kumar Sahu et al that found more number of failure cases (25)and the success ratio in current study was up to 95% with no serious complication and no significant difference in age, there were higher successful when compared with Yang et al that found successes ratio 87.9% because our physicians are more experience.^[11]

Our study showed that there is no significant difference between difficulty and US guidance which disagree with Sorayouth Chumnavej that successful ratio are lower than in this study because SNRB reported that facet echo edge was identified by US, it is not easy to have clear view for facet echo in all patients and it is difficult to place the needle tip at facet echo edge under US, we think that is causes for their lower successful ratio because the nerve root is deep within the foramen and it can't be easily visualized under US guidance.^[12]

Our study also showed that there is no significant difference between gender and with US difficulty that agree with Sorayouth Chumnavej because ultrasound use low frequency and identify the anatomical target and make it feasible to perform SNRB.^[12]

We used dye spread to confirm successful ratio that agree with Preeti Soni because the presence of dye in ventral intraforaminal space confirm the position of needle and contrast spread under fluoroscopy guidance.^[13]

Our study showed that there were no significant association between US difficulty and different age group that disagree with Sorayouth Chumnavej MD that found degeneration and osteophyte of spine in older age cases deterioration of US identification when compared to some younger patients.^[12]

CONCLUSION

Ultrasound guided lumbar transforaminal epidural injections are accurate and practical in clinical cases with successful rate of 95%.

REFERENCES

1. MERSKEY H, Bogduk N. Classification of chronic pain; Description of chronic pain syndromes and definitions of pain Terms. 2nd ed. IASP Press, 1994.
2. van Tulder M, Becker A, Bekkering T, Breen A, Gil del Real MT, Hutchinson A, et al. Chapter 3 European guidelines for the management of acute nonspecific low back pain in primary care. Eur Spine J., 2006 Mar; 15(S2): s169–91.
3. Fishman SM, Ballantyne JC, Rathmell JP. Bonica's Management of Pain, 4th Edition. Anesthesiology, 2010 Dec 1; 113(6): 1482–3.
4. van Kleef M, Vanelderen P, Cohen SP, Lataster A, Van Zundert J, Mekhail N. 12. Pain originating from the lumbar facet joints. Pain Pract, 2010 Oct; 10(5): 459–69.
5. Vanelderen P, Szadek K, Cohen SP, De Witte J, Lataster A, Patijn J, et al. Sacroiliac joint pain. Pain Pract, 2010 Oct; 10(5): 470–8.
6. Kallewaard JW, Terheggen MABM, Groen GJ, Sluiter ME, Derby rR, Kapural L, et al. discogenic low back pain,pain practice, 2010; 560–79 p.
7. Van Boxem K, Cheng J, Patijn J, van Kleef M, Lataster A, Mekhail N, et al. 11. Lumbosacral radicular pain. Pain Pract, 2010 Aug; 10(4): 339–58.
8. Patijn J, Mekhail N, Hayek S, Lataster A, van Kleef M, Van Zundert J. Meralgia Paresthetica. Pain Pract, 2011 Jun; 11(3): 302–8.
9. Thackeray A, Fritz J, Brennan G, Zaman F, Willick S. A Pilot Study Examining the Effectiveness of Physical Therapy as an Adjunct to Selective Nerve Root Block in the Treatment of Lumbar Radicular Pain From Disk Herniation: A Randomized Controlled Trial. Physical therapy, 2010 Dec 1; 90: 1717–29.
10. Liu SS, Ngeow J, John RS. Evidence Basis for Ultrasound-Guided Block Characteristics: Onset, Quality, and Duration. Reg Anesth Pain Med, 2010 Feb 1; 35(Suppl 1): S26–35.
11. Yang G, Liu J, Ma L, Cai Z, Meng C, Qi S, et al. Ultrasound-guided Versus Fluoroscopy-controlled Lumbar Transforaminal Epidural Injections: A

- Prospective Randomized Clinical Trial. Clin J Pain, 2016 Feb; 32(2): 103–8.
12. Chumnavej S, Wetchagama N, Kounsongtham V. Accuracy of needle-tip localization by ultrasound guidance lumbar selective nerve root block: A prospective clinical study of 78 lumbar nerve roots block. Journal of the Medical Association of Thailand = Chotmaihet thangphaet, 2011 Dec 1; 94: 1451–6.
 13. Preeti Soni, Jyotsna Punj. Ultrasound-Guided Lumbar Transforaminal Epidural Injection: A Narrative Review. Asian Spine J., 2020 Jun; 8.