Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/6498
DOI URL: http://dx.doi.org/10.21474/IJAR01/6498

*RESEARCH ARTICLE*

# EVALUATION OF USE OF ULTRASOUND IMAGING IN SPINAL ANAESTHESIA IN PATIENTS WITH DIFFICULT SURFACE ANATOMICAL LANDMARKS.

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## *Manuscript Info*

***Manuscript History***

Received: 10 December 2017
Final Accepted: 12 January 2018
Published: February 2018

**Keywords:-**
Spinal anaesthesia, ultrasound, difficult surface landmarks.

## *Abstract*

**Background:** Indirect visualization of spinal canal with ultrasound can reduce difficulties and complications occurring due to blind nature of procedure. If an inter laminar window that permits passage of sound waves into the vertebral canal can be identified, the same window will permit passage of a needle into the intrathecal space.
**Aim:** To evaluate the use of ultrasound imaging for ease of spinal anesthesia in patients with difficult surface anatomical landmarks.
**Methods:** 60 patients of ASA I, II and III status with age more than 20 years, were divided in two groups; control group [Group LM] received spinal anaesthesia with conventional landmark guided method. In study group [Group US] pre-procedural ultrasound imaging of lumbar spine was done and point for lumbar puncture was identified and marked. Observations about number of needle attempts, number of needle redirections, time required etc. were recorded.
**Results:** The number of patients requiring more than two needle attempts for successful puncture were significantly lower in USG guided group as compared to surface landmark group . The difference came out to be statistically significant (P = 0.039).
**Conclusion:** Pre-procedure inter-vertebral space imaging of lumbar spine with USG can help us to reduce number of needle puncture, number of needle redirection, and will also reduce the procedure time, leading to lesser complication, and improved patient comfort.



## Introduction:-

Spinal anesthesia is practiced with experience and knowledge about surface anatomical landmarks of lumbar spine. Certain factors like old age, deformity of spine, obesity and operated spine can make the process difficult and at times impossible, requiring multiple dural punctures and needle passes, leading to complications.

Indirect visualization of spinal canal with ultrasound can reduce difficulties and complications occurring due to blind nature of procedure. If an inter laminar window that permits passage of sound waves into the vertebral canal can be identified, the same window will permit passage of a needle into the intra thecal space [1].

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## Material and Methods:-

Patients with difficult surface anatomical landmarks were identified in pre-operative evaluation.
The difficulty level of surface landmark was graded according to 4 point scale: easy; 2 moderate; 3 difficult; 4 impossible [ 2 ]

60 patients of ASA I, II and III status, with age more than 20 years, were divided in two groups. The control group [group LM] received spinal anesthesia with conventional landmark guided method. In study group [group US], pre-procedural ultrasound imaging of lumbar spine was done and point for lumbar puncture was identified and marked. Observations about number of needle attempts, number of needle redirections, time required etc. were recorded.

### Group US:-

Pre-procedural ultrasound imaging was done in the pre-operative room in sitting position. Procedure was completely non-invasive. Needle entry point was marked on desired lumber interspinous space. The USG imaging of lumbar spine was performed by Sonosite ultrasound machine with low frequency (2-5 MHz) curvilinear transducer.

The probe was oriented longitudinally to obtain a parasagittal oblique view of the lumbosacral spine in which L2 – L3 to L4 – L5 interlaminar space was identified and marked by counting upward from the sacrum. The probe was rotated 90 degree to obtain a transverse view of the lumbar spine. The L2- L3 to L4-L5 interspinous and interlaminar space was identified by visualizing the intrathecal space between the ligamentum flavum - duramater complex and the posterior aspect of the vertebral body. The midline (interspinous ligament) of vertebral column and location of interlaminar space was marked on the skin. The transducer was kept steady. Two marks were drawn on skin. One point coincided with centre of the upper horizontal surface of probe (midline) and other coinciding with the midpoint of right lateral vertical surface of probe. The puncture site was determined by intersection of two lines from these marks on skin on vertical and horizontal space [3]. With the aid of bilt-in caliper, we measured ultrasound depth to reach epidural space from skin to the inner surface of the ligamentum flavum duramater unit. The intersection of these two markings was used to guide a midline approach to spinal anesthesia. Patient was placed in sitting position. Spinal anesthesia was performed under all aseptic precautions. Dural puncture was performed with the help of the entry point, with 25G , 89mm Quincke needle.

## Observation and Results:-

**Table no. 1:-** The distribution of difficulty identification scale across two study groups.

| Difficulty Identification scale | Group 1 (n=30) [USG Guided] | | Group 2 (n=30) [Landmark Guided] | | P-value [Inter-Group] |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Difficult | 29 | 96.7 | 30 | 100.0 | $0.999^{NS}$ |
| Impossible | 1 | 3.3 | 0 | 0.0 | |
| **Total** | **30** | **100.0** | **30** | **100.0** | |

Values are n (% of cases). P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. * P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

**Comments:-**

1. The distribution of difficulty identification scale did not differ significantly between two study groups (P-value>0.05).
2. In both the study groups, the majority of cases studied had difficult scale (96.7% in Group 1 and 100.0% in Group 2).

**Table 2:-** The distribution of number of needle attempts across two study groups.

| Needle Attempts | Group 1 (n=30) [USG Guided] | | Group 2 (n=30) [Landmark Guided] | | P-value [Inter-Group] |
|---|---|---|---|---|---|
| | n | % | n | % | |
| 1 | 26 | 86.7 | 16 | 53.4 | $0.039^{*}$ |
| 2 | 4 | 13.3 | 12 | 40.0 | |
| 3 | 0 | 0.0 | 1 | 3.3 | |
| 4 | 0 | 0.0 | 1 | 3.3 | |
| **Total** | **30** | **100.0** | **30** | **100.0** | |

Values are n (% of cases). P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. * P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

**Comments:-**

1. The mean ± SD of no. of needle attempts from in Group 1 and Group 2 was 1.13 ± 0.35 and 1.57 ± 0.73 respectively.
2. The distribution of no. of needle attempts differs significantly between two study groups (P-value<0.05).

Significantly higher proportion of cases from group 1 required relatively lesser no. of needle

**Table 3:-** The distribution of number of needle redirections across two study groups.

| No. of Needle Redirections | Group 1 (n=30) [USG Guided] | | Group 2 (n=30) [Landmark Guided] | | P-value [Inter-Group] |
|---|---|---|---|---|---|
| | n | % | n | % | |
| 0 | 9 | 30.0 | 1 | 3.3 | 0.023* |
| 1 | 12 | 40.0 | 11 | 36.7 | |
| 2 | 7 | 23.3 | 15 | 50.0 | |
| >2 | 2 | 6.7 | 3 | 10.0 | |
| **Total** | **30** | **100.0** | **30** | **100.0** | |

Values are n (% of cases). P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. * P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

**Comments:-**

1. The mean ± SD of no. of needle redirections from in Group 1 and Group 2 was 1.07 ± 0.91 and 1.80 ± 1.19 respectively.
2. The distribution of no. of needle redirections differs significantly between two study groups (P-value<0.05).
3. In study group 1, the majority of cases studied had 1 needle redirections (40.0% cases). In study group 2, the majority of cases studied had 2 needle redirections (50.0% cases). Significantly higher proportion of cases from Group 2 required relatively higher no. of needle redirection compared to Group1 cases (P-value<0.05).

**Table 4:-** The distribution of median time required for successful puncture across two study groups.

| | Group 1 (n=30) [USG Guided] | | Group 2 (n=30) [Landmark Guided] | | P-value [Inter-Group] |
|---|---|---|---|---|---|
| | Median | Min – Max | Median | Min – Max | |
| **Time Required (mins)** | 3.00 | 2.0 – 15.0 | 5.00 | 1.0 – 30.0 | 0.033* |

Values are Median and Min - Max. P-value by Mann-Whitney U test. P-value<0.05 is considered to be statistically significant. * P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

**Comments:-**

1. The distribution of median time required for successful puncture in Group 1 and Group 2 cases was 3.00 min and 5.00 min respectively.

The distribution of median duration time required for successful puncture differs significantly between two study groups (P-value<0.05). The median time required for successful punctures is significantly lower in Group 1 compared to Group 2 (P-value<0.05).

**Table 5:-** The distribution of incidence of change in different events across two study groups.

| Events | Group 1 (n=30) [USG Guided] | | Group 2 (n=30) [Landmark Guided] | | P-value [Inter-Group] |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Space Change | 4 | 13.3 | 12 | 40.0 | 0.039* |
| Needle Change | 0 | 0.0 | 3 | 10.0 | 0.237NS |
| Person Change | 2 | 6.7 | 3 | 10.0 | 0.999NS |

Values are n (% of cases). P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. * P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

**Comments:**

1) The distribution of incidence of change in space differs significantly between two study groups (P-value<0.05). Significantly higher proportion of cases from Group 2 had higher incidence of space change compared to the cases from Group 1 (P-value<0.05).
2) The distribution of incidence of change in different events such as needle change and person change did not differ significantly between two study groups (P-value>0.05 for all).

**Table 6:-** The distribution of quality of spinal across two study groups.

| Quality of spinal | Group 1 (n=30) [USG Guided] | | Group 2 (n=30) [Landmark Guided] | | P-value [Inter-Group] |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Adequate | 30 | 100.0 | 30 | 100.0 | $0.999^{NS}$ |
| Inadequate | 0 | 0.0 | 0 | 0.0 | |
| **Total** | **30** | **100.0** | **30** | **100.0** | |

Values are n (% of cases). P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. * P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

**Comments:-**

1. The distribution of quality of spinal did not differ significantly between two study groups (P-value>0.05).
2. In both the study groups, all cases had adequate quality of spinal (100.0% in Group 1 and 100.0% in Group 2).

## Discussion:-

Subarachnoid blocks are daily practice procedures for anaesthesiologists. The use of the traditional landmark guided technique in subarachnoid block can be extremely challenging in patients with difficult surface anatomical landmarks [4].

Reducing the technical difficulties of neuraxial blockade is desirable because multiple needle insertion attempts may increase the risk of complications [5].

Landmarks based approach does not take into account all anatomical variations or abnormalities and frequently lead to incorrect identification of a given lumbar interspace. Having alternative approaches may help improve success and mitigate the limitations of the current techniques [6].

Ultrasound imaging of the spine has recently been proposed to facilitate identification of the anatomical landmarks for subarachnoid blockade [7].

Guardabassi in 2014 described the utility of ultrasound in neuraxial blockade by its usefulness to identify and mark intervertebral levels, needle insertion point for a midline approach and also to estimate needle orientation and depth from skin surface to subarachnoid space [8].

Abd el Hamid et al in 2013 described using transverse approach for identification of anatomical landmarks [9].
Chin et al in 2011 described that technical difficulty of neuraxial blockade is measured using two main parameters: the number of needle manipulations required for success and time taken to perform the block. Out of two, the former is more important because multiple needle insertions are an independent predictor of complications [10].

In our study we have observed the conditions where spinal could be extremely difficult, like in painful positioning due to various conditions in groin region, example gangrene and bed sore, and here identification of window was difficult. Real time technique can be of great help in such conditions. With this simple measure of identification of difficulty level in pre-op evaluation, outcomes can be improved. USG can be of great help in this aspect.

## Conclusion:-

Pre-procedure inter-vertebral space imaging of lumbar spine with USG can help us to reduce number of needle puncture, number of needle redirection, and will also reduce the procedure time, leading to lesser complication, and improved patient comfort.

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