

## Original Research Article

# A comparison of three different gauge Quincke's spinal needles in patients undergoing elective surgery under spinal anaesthesia: a prospective randomized study

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**Received:** 27 August 2019

**Revised:** 31 August 2019

**Accepted:** 27 September 2019

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### ABSTRACT

**Background:** The present study was conducted to compare three different Quincke's spinal needles i.e. 23, 25 and 26 gauge in patients undergoing elective surgery under spinal anaesthesia (SA).

**Methods:** The prospective randomized double-blind study was conducted on 150 male patients in the age group of 18-50 yrs., having physical status class I to II, scheduled for elective surgery under SA. Patients were randomly divided into three groups comprising 50 patients each. SA was administered using Quincke's spinal needles of 23, 25 and 26 gauge in group 1, 2 and 3 respectively. Ease of insertion, number of attempts and time of appearance of CSF and incidence of PDPH was recorded in all the patients.

**Results:** Ease of insertion was graded easy in 98%, 84% and 82% in group 1, 2 and 3 respectively. First attempt success rate was highest in group 1, (98%). Meantime for appearance of CSF beyond hub was maximum in group 3 i.e.  $14.60 \pm 2.56$  sec. Mild PDPH was reported in 6% and 2% patients after 24 hrs in group 1 and group 2 respectively.

**Conclusions:** Finer spinal needle proved to be more dependable in generating less traumatic effect on the dura and preventing PDPH but are technically more difficult thus decreasing first attempt success rate.

**Keywords:** Needle gauge, Post-dural puncture headache, Quincke's needle, Spinal needles, Spinal needle technical difficulty

### INTRODUCTION

Spinal needles are used frequently in the everyday practice of an anesthesiologist for performing neuraxial procedures. Spinal needles have been modified to simplify their use and minimize complications. Needle diameter, tip design and orifice location, have been altered to enable rapid flow of cerebral spinal fluid (CSF) and simultaneously limit dural trauma and loss of CSF.<sup>1</sup>

A wide range of needles of different types and sizes are currently available for spinal anesthesia (SA). The needles are classified according to their gauge and shape. Spinal needles in common use today are 23 to 27 G, but

various authors documented that the needles ideal for spinal anesthesia are 25, 26 and 27 G.<sup>2</sup>

The ideal spinal needle should be easy to use, should have a low failure rate and be associated with a low incidence of post-dural puncture headache (PDPH). The important features which determine the ease of use of spinal needles include rapid confirmation of CSF detection, minimal delay in injecting local anesthetic and low resistance to injection, and less chance of dislodging the needle position.<sup>1,3</sup>

Wide bore needles are technically easy to use but simultaneously result in increased chances of PDPH and

more tissue damage, causing backache. The severe PDPH and backache hence offset the benefits of spinal anesthesia.<sup>2,4,5</sup> Compared to wide bore spinal needles, smaller diameter needle had an advantage of decreased incidence of PDPH, but it bears some disadvantages too. The smaller needle is technically more difficult to use resulting in increased incidence of failure, because of the slower CSF flow characteristics, aspiration difficulty and increased needle flexibility. Flexibility can result in deflection and bending of needle, deformation of the needle tip due to bony contact and difficult detection of the subarachnoid space resulting in multiple dural punctures. Multiple holes in the dura, will further increase the incidence of headache.<sup>6-8</sup> Technical difficulty while using thinner needles further hampers the first attempt success rate and increases failure of block.<sup>5,9,10</sup> Considering how the needle gauge affects the performance of SA and how this can interfere with success of SA, authors compared the different gauge spinal needles i.e. 23, 25 and 26 G needles with regards to technical difficulty, success rate, quality of block and complications.

## METHODS

This prospective randomized and double-blind study was conducted from period January 2018 to March 2019 after approval from institutional ethical committee and informed consent from all the participants was obtained.

### *Inclusion criteria*

A total of 150 adult males aged between 18-50 years, belonging to American Society of Anesthesiologists (ASA) physical status I and II scheduled for elective surgery under SA were selected to participate in the study.

### *Exclusion criteria*

Patients having morbid obesity, vertebral deformities and coagulation abnormalities were excluded from the study.

Patients were examined pre-operatively and all required investigations were carried out. Baseline readings of vital parameters were noted on arrival to OR. Patients were randomly allocated using sealed envelope containing code numbers to one of the three groups. SA was administered using Quincke's spinal needles of 23, 25 and 26 gauge in group 1(n=50), group 2 (n=50) and group 3(n=50) respectively. Under all aseptic precautions, SA was administered in sitting position at the L3-L4 interspace using spinal needle as per group allocated. Hyperbaric bupivacaine heavy 2.8ml was injected intrathecally. Ease of insertion for performing lumbar puncture was noted and was graded on four-point scale: grade 1 (easy), 2 (slightly difficult), 3 (difficult) and 4 (failure). Easy: when no resistance to tissue force encountered and no needle deformation was observed. Slightly difficult: when mild resistance to tissue force encountered and mild needle deformation observed.

Difficult: when gross resistance to tissue force encountered and gross needle deformation observed. Failure of needle insertion: unable to negotiate the spinal needle. Number of attempts were recorded (More than three attempts were considered a failure). Time of appearance of CSF beyond hub was noted.

Sensory block (SB) was assessed by every 1 minute till 5 minutes and reassessed every 5 minutes for 30 minutes. Time of onset of sensory block till T8, maximum height of SB achieved, time to achieve maximum sensory height and time of regression of SB till L2 was recorded. Degree of motor block (MB) was assessed using modified Bromage Score.<sup>11</sup> MB was assessed at the same interval as sensory block. Onset time of motor blockade (till Bromage score of 3 achieved) and duration of block was noted (till Bromage score back to zero). Heart rate and mean arterial pressure variation in three groups were recorded every 1 minute till 5 minutes and thereafter every 5 minutes till 30 minutes then after every 15 minutes till the end of surgery. Patients were questioned 24 hr., 48 hr. and 72 hrs. after surgery for complaint of PDPH which was classified on the basis of lybecker classification as mild, moderate and severe.<sup>12</sup> Any complaint of backache was also taken into account.

### *Statistical analysis*

The comparison of normally distributed continuous variables between the groups was performed using Student's t-test. Within the group comparisons, the significance was calculated using paired t-test at different time points from Baseline. Nominal categorical data between the groups were compared using Chi-squared test or Fisher's exact test as appropriate.  $p < 0.05$  was considered statistically significant.

## RESULTS

The distribution of age, weight and height among the three groups, which were comparable statistically. Ease of insertion was graded easy in 98%, 84% and 82% in group 1, 2 and 3 respectively. Ease of insertion, number of attempts and time of appearance is shown in table 2. First attempt success rate was highest in group 1, (98%) and least in group 3 i.e. 80%. Meantime for appearance of CSF beyond hub was maximum in group 3 i.e.  $14.60 \pm 2.56$  sec and least in group 1 i.e.  $4.14 \pm 1.81$  sec. In group 2 it was calculated as  $11.48 \pm 2.59$  second ( $p < 0.001$ ) (Table 1). Characteristics of sensory and motor block are represented in table 3. Variation in mean HR and MAP in the groups is graphically represented in figure 1 and 2 respectively. Mild PDPH was reported in 6% and 2% patients after 24 hrs. in group 1 and group 2 respectively which persisted in one patient (2%) after 48 hrs. PDPH was not reported by any patient in group 3. None of the patient complained PDPH on 72 hrs. following SA in any group. Backache was reported by only 3 patients in group 1 and 2 patients each in group and 3. Incidence of PDPH and backache were both statistically non-significant.

**Table 1: Demographic data.**

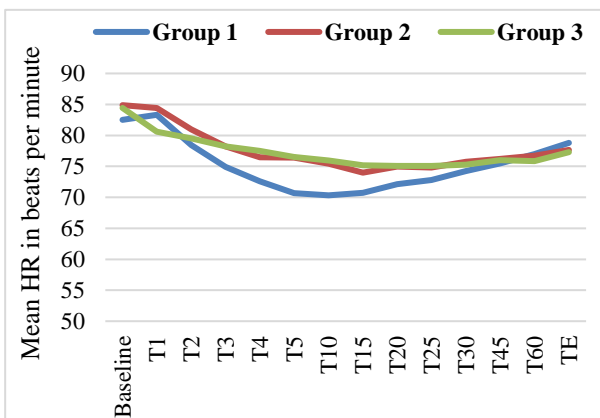
Demographic parameters	Group 1 Mean±Sd	Group 2 Mean±Sd	Group 3 Mean±Sd	p value
Age (YRS)	33.58±11.14	31.60±9.72	33.70±9.96	0.513
Weight (KGS)	67.24±4.96	67.20±6.72	65.72±5.42	0.324
Height (CMS)	171.36±2.94	171.04±2.77	172.32±4.00	0.131

**Table 2: Insertion, no. of attempts and Time of appearance of CSF.**

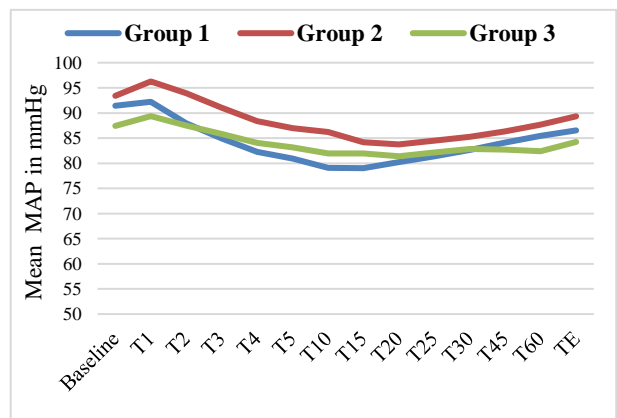
Needle characteristic parameters		Group 1	Group 2	Group 3	P value	Group 1 v/s group 2	Group 1 v/s group 3	Group 2 v/s group 3
Ease of insertion	Easy	49(98%)	42(84%)	41(82%)	0.006	0.01	0.028	0.368
	Slightly difficult	1(2%)	6(12%)	8(16%)				
	Difficult	0	2(4%)	1(2%)				
No. Of attempts	1	49(98%)	42(84%)	40(80%)	0.002	<0.01	0.015	0.285
	2	1(2%)	5(10%)	8(16%)				
	3	0	3(6%)	2(4%)				
Time of appearance of CSF beyond hub (secs)		4.14±1.81	11.48±2.59	14.60±2.56	<0.001	<0.001	<0.001	<0.001

**Table 3: Characteristics of sensory and motor block.**

Sensory and motor block results		Group 1 Mean±SD	Group 2 Mean±SD	Group 3 Mean±SD	P value
Time of onset of sb till t8(min)		3.65±1.02	4.75±1.88	5.37±1.73	<0.001
Time to achieve maximum height of sb (min)		5.22±3.88	5.45±7.27	6.27±3.10	0.034
Time of regression of sb till 12 (min)		120.10±20.62	129.38±16.59	123.80±12.44	0.028
Maximum height of sensory blockade	T10	4(8.00%)	11(22.0%)	1(2.0%)	0.015
	T8	35(70.0%)	28(56.0%)	37(74.0%)	
	T6	11(22.0%)	9(18.0%)	8(16.0%)	
	Failure	0(0.00%)	2(4.0%)	4(8.0%)	
Time to achieve mb till bromage 3 (sec)		6.28±3.20	11.70±4.06	12.52±2.69	<0.001
Onset of mb (min)		179.60±20.82	185.21±16.76	187.32±9.74	<0.001



**Figure 1: Comparison of HR among three groups.**



**Figure 2: Comparison of MAP among three groups.**

## DISCUSSION

For performing SA, good and appropriate size spinal needles should be used for minimizing the complications and achieving good success rate. The ideal spinal needle should be easy to use, should have a low failure rate, rapid confirmation of CSF detection, minimal delay before injection of local anesthetic and should be associated with a low incidence of PDPH.<sup>7,8</sup>

Spinal needles were evaluated for ease of insertion. It was graded easy in maximum number of subjects (98%) in group 1. In group 2 and 3 ease of insertion decreased to 84% and 82% respectively. Slight difficulty was encountered in 12% and 16% subjects with 25 gauge and 26-gauge needle respectively. Hence difficulty level was found to be slightly higher in group 3. Kumar et al examined 25 G Quincke needle for technical difficulty and documented 96% success rate which was higher than our observation. Hence needle gauge largely contributes to ease of insertion. Thicker needle adds to more stability whereas thinner needles are difficult to handle and likely to deform easily.<sup>13</sup> Technical experience is considered, important factor in improving the success of needle insertion, as less experienced trainees are expected to bend the finer gauge needles more and bent needle becomes more difficult to be negotiated further.<sup>8</sup> Authors suggest that 23 gauge needle can be recommended for use of novice resident to achieve better success in spinal anesthesia and thinner needle should be used by experienced clinician.

First attempt success rate was highest in (98%) in group 1. Group 2 and 3 had minimal difference in success of 1st attempt (84% and 80% respectively) in current study. Bajwa et al recorded first attempt success rate with 23 G spinal needle as 92.8% and with 86.2% with 26 G spinal needle.<sup>9</sup> Mohammed et al reported 85% 1st attempt success with 25 G Quincke needle.<sup>10</sup> Oberhofer when examined 26-gauge spinal, recorded first attempt success rate of 72.9% and second attempt success rate as 20.3%.<sup>5</sup> Low success rate was due to enrollment of parturient in their study. Technical difficulty increases in pregnant patient because of increased lordosis which results in difficulty in opening of lumbar interspace which further decreased the first attempt success rate in their study. First attempt Success rate of 92% was noted by Shah et al on using 25 G spinal needle.<sup>6</sup>

Though variability in results were observed by investigators but common conclusion was drawn that the larger gauge needles results in excellent first attempt success. On the other hand, thinner needle was more difficult to negotiate because bending occurs frequently with finer gauge needles and needle deviates from the axis of insertion thus compromising the success rate. Appropriate solution to this problem is to insert fine-gauge needles through an introducer. This protects the spinal needle tip from unnecessary damage and maintains the needle along the axis of insertion.<sup>8,14</sup>

Time of appearance of CSF was significantly prolonged with 26 G Quincke spinal needle ( $14.60 \pm 2.56$  sec) as compared to  $4.14 \pm 1.81$  seconds and  $11.48 \pm 2.59$  sec in group 1 and group 2 respectively. Similar observation was noted by Shah et al and Mohammed et al.<sup>6,10</sup> CSF detection time directly depends on internal diameter of the needle. Smaller the internal diameter, greater is the time of detection. This can be explained by Poiseuille equation, which states that flow is laminar through a pipe of constant circular cross section that is substantially longer than its diameter and there is no acceleration of fluid in the pipe. For velocities and pipe diameters above a threshold, actual fluid flow is not laminar but turbulent leading to larger pressure drops  $\Delta P = 8\mu LQ/IR$  (Hagen Poiseuille equation).<sup>15</sup> Early CSF detection time is not of much significance except it can help in rapid drug injection and early onset of block, which can be useful in situation of busy operating schedules.<sup>6</sup>

Mean time of onset of SB was recorded and was observed highest in group 3 in our study. It was observed that needle with least internal diameter results in delayed onset of SB. Similar findings were observed by Mohammed et al.<sup>10</sup> This delay in the SB can be due to reason that fine gauge needle causes increased resistance which results in prolonged injection time of LA and hence delay in onset of block. Maximum height of SB achieved was noted and was observed that large number of patients achieved block till T8 in all the three groups. Failure of block was maximum with 26-gauge needle and minimum with 23-gauge needle. Improper placement of bevel because of smaller bevel size may be the possible reason for more failure with thinner needle. This might result in leaking of LA into subdural or epidural space resulting in block failure. Time to achieve maximum sensory height was prolonged with fine spinal needle in the present study and was found to be statistically significant. Investigators believed that this could be due to delay in injecting LA through smaller gauge needle because of the increased resistance.<sup>10</sup> Statistically significant difference was observed in present study when authors compared time to achieve maximum degree of bromage between the groups. Increased duration was observed with 25 G and 26 G needles. This can be possibly due to the reason that delayed drug administration because of small diameter needle, may result in delayed drug response.

Haemodynamic changes were clinically insignificant and no patient in either group required active intervention in form of vasopressors and iv fluids. Drop in MAP and HR was observed following administration of SA till 15 minutes. This drop is attributed to drug induced sympathetic blockade.

The frequency of PDPH was noted and it was observed that incidence of PDPH was 6% with 23 G and 2% with 25 gauge and almost nil with 26 G spinal needle. PDPH was of mild intensity in all the patients except for single patient in both the groups, in whom intensity turned

moderate in nature at 48 hours. Patients responded to bed rest, fluid replacement and analgesic and were symptom free at 72 hours. Though ease of insertion and first attempt success rate was better with 23 gauge but incidence of PDPH was more because of well-known reason that wide bore needles produce larger holes in the dura mater and leading to more risk of PDPH. On the other hand, in group 2 and 3 patients, ease of insertion and first attempt success rate was slightly inferior to group 1 but small dural hole due to thinner diameter prevents the problem of PDPH. Joshi et al reported incidence of PDPH with Quincke's needle of size 23 G and 25 G to be (10%) and (8%) respectively.<sup>16</sup> Shah et al reported 14% incidence of PDPH with 25 G Quincke's needle<sup>6</sup> and Babu et al observed 20%, 12.5% and 4.5% incidence of PDPH with 23 g, 25g and 26 g needles respectively.<sup>17</sup> Irkal et al and Ayub et al used 25g spinal needle and their incidence was 18% and 14.5% respectively. In all the above studies occurrence of PDPH was more as compared to our study.<sup>18,19</sup> This variation in results can be due inclusion of both sexes in other studies as compared to only males in our study and may be due to difference in experience of investigator.

## CONCLUSION

Authors concluded that success rate principally depends on technique used, experience of investigator, size and configuration of the spinal needle. Among these factors needle gauge being the paramount factor followed by technical experience. Finer spinal needle proved to be more dependable than larger bore needles in generating less traumatic effect on the dura and additionally preventing PDPH. But inexperienced trainee is expected to bend them and rendering them more difficult to negotiate further. Simultaneously smaller diameter needle becomes technically more difficult leading to multiple attempts, resulting in increased incidence of backache.

## ACKNOWLEDGEMENTS

Kindly accept the above-mentioned manuscript as research work for publication in your esteemed journal. All authors have contributed to, and read the paper, and have given permission for their names to be included as co-authors. Manuscript has not already been published and will not be submitted simultaneously or published elsewhere. No financial grants have been received for the study.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Kaur K, Singhal K, Mehla A. A comparison of three different gauge Quincke's spinal needles in patients undergoing elective surgery under spinal anaesthesia: a prospective randomized study. *Int J Res Med Sci* 2019;7:4188-93.