Comparative Study on the Effects and Complications of Transverse Insertion of Two Fine Gauge Quincke's Spinal Needles 26 and 29 G in Spinal Anesthesia

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Abstract

Introduction: Spinal anesthesia is one of the most commonly used techniques in modern anesthesia. Spinal needles have evolved over time to increase efficacy and decrease complications. Fine gauge spinal needles technically consume more time but are advisable in certain clinical conditions such as raised intracranial pressure and when patient well-being and comfort are the priorities. Hence, we undertook this study to compare the effects and complication of transverse insertion of Quincke's spinal needle 26 G (gauge) and 29 G. **Materials and Methods:** Hundred patients of age 18–40 years posted for lower abdominal and lower limb surgeries were allocated into two groups of 50 each to receive spinal anesthesia with 3 ml of 0.5% bupivacaine using 26 G or 29 G Quincke's spinal needle. All the patients were evaluated for the time of drug administration, number of attempts, time to attain sensory blockade up to T8 level, time to attain motor blockade up to bromage Grade 3, and incidence of post-dural puncture headache (PDPH) and post-dural puncture backache. **Results:** Demographic data were comparable in both groups. The PDPH incidence on 3rd day for 29 G Quincke's was 0% while for 26 G Quincke's was 12%. There was statistically significant difference when 26 G Quincke's was compared with 29 G Quincke's for number of attempts, time of drug administration, time to attain motor and sensory block. **Conclusion:** 29 G Quincke's spinal could be used to provide spinal anesthesia in young adult patients owing to adequate sensory and motor blockade with no incidence of PDPH and backache.

Keywords: Back pain, headache, needle, spinal anesthesia

Introduction

Spinal anesthesia is a widely used procedure in modern anesthesia. Spinal needles have evolved over time with respect to needle design such as diameter, needle tip, and location of orifice. The spinal needles are classified according to their gauge and shape.[1] Larger 22 G (gauge) and 23 G spinal needles provide effective sensory and motor blockade but there is increased frequency of post-dural puncture headache (PDPH), unstable hemodynamics, paresthesia, nausea, vomiting, and shivering.[2]

The incidence of PDPH ranges from 0% to 37%.[3] The most important factors influencing the frequency and severity of PDPH are the patient's age, size of dural puncture, and number of attempts required for achieving dural puncture.[4,5] PDPH is also related to the type of spinal needle used, orientation of bevel, the angle of insertion to dural fibers, number of lumbar puncture attempts, whether midline or lateral lumbar puncture approach is used, the local anesthetic used, clinical experience of operator and the stylet placement.[6] Backache after spinal anesthesia presents in the initial 2–6 h after the procedure as local anesthetics used during the procedure wean off.[7] Concurrently administered analgesic medications, may delay backache being noticed by a day or 2. Backache starting 3–5 days after procedure indicates complication. Sometimes, pain persist for few weeks and in rare cases backache may be persistent because of nerve injury during needle placement.

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Wide-bore needles may cause tissue damage resulting in backache.[8]

Our main aim in regional anesthesia is to provide stable hemodynamics and effective sensory and motor blockade with minimal or no complications. There is a paucity of data in the Indian population regarding effects of fine-bore spinal needles in spinal anesthesia. Hence, we undertook this study to compare the effects and complication of transverse insertion of Quincke's spinal needle (26 and 29 G) in terms of number of attempts, degree of sensory and motor blockade, effect on hemodynamics and incidence and severity of PDPH and back pain.

Materials and Methods

Study design

This was a prospective, comparative, and randomized study.

Study setting

This study was conducted after obtaining ethical committee clearance, IEC no 1726 dated March 13, 2020, on 100 American Society of Anaesthesia (ASA) I/II patients of age between 18 and 40 years posted for elective lower abdominal/lower limb surgical procedure over a period of 24 months. Patients with a history of chronic headache/migraine, chronic backache, morbid obesity (body mass index >25), on anticoagulant therapy were excluded from the study. The patient was randomly allocated to one of the two groups. Randomization was done by computer generated program. Group I patients received spinal anesthesia with 26 G Quincke's spinal needle whereas Group II patients were given spinal anesthesia with 29 G Quincke's spinal needle [Figure 1].

Sample size

A *post hoc* power analysis was conducted using the software package, G*Power (Erdfelder, Faul & Buchner from Heinrich Heine University, Dusseldorf, North Rhine-Westphalia, Germany). The alpha level used for this analysis was $P < 0.05$ and the beta was 0.20. The sample size was estimated from the results of the previous study using the incidence of PDPH as the parameter, which is the primary outcome of our study.[3] Our sample size came out to be 50 subjects per group at power of 0.95 and with an effect size of 0.36 with 10% chance of error with $\alpha = 0.05$, $\beta = 0.20$ and confidence interval of 95%.

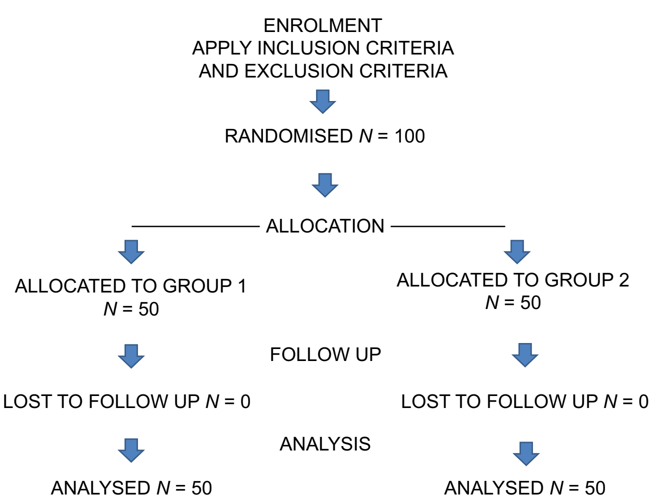

Figure 1: Consort diagram

Informed consent

The patient was informed about the procedure and informed risk consent was taken in English/Hindi. All the procedures followed the guidelines laid down in the Declaration of Helsinki.

Anaesthesia technique

Pre-anesthetic check-up was done a day before surgery. Patients were kept nil per oral for 6 h. In the preoperative period, patients were preloaded with 10–20 ml/kg isotonic fluid through 18 G cannula secured on the nondominant hand. In the operating room electrocardiogram, peripheral oxygen saturation and noninvasive blood pressure were monitored. Spinal anesthesia was given in a sitting position in midline approach at L3/L4 or L4/L5 intervertebral space. The procedure was done by the senior faculty with experience of at least 5 years in the department. In the first attempt, a 20 G introducer needle was inserted in the midline at the selected space after local infiltration with 2% lignocaine, followed by the introduction of Quincke's spinal needle through it. If it failed then in 2nd attempt the whole procedure was again repeated by adjusting the direction of the needle. 3 ml of bupivacaine heavy (0.5%) was given after aspiration of clear cerebrospinal fluid (CSF). A maximum of 2 attempts were allowed before declaring failed spinal for that needle. Rescue spinal anesthesia was attempted with 25 G Quincke's spinal needle for a maximum of two attempts. The patient was turned supine and sensory and motor block was assessed every 2 min. Surgery was allowed after attaining appropriate sensory and motor blockade. In case of failed spinal anesthesia or inadequate effect, conversion to general anesthesia was done. The parameters recorded were time of drug administration, number of attempts, time taken to achieve T8 sensory block and bromage Grade 3, and hemodynamic variables (heart rate, mean arterial pressure, Spo_2) were measured every 5 min for 30 min.

Postoperatively patients were evaluated for PDPH and backache.

1. PDPH-The patient was interviewed after 24 h of giving

Figure 2: Demographic profile of patients

	Group 1	Group 2	P
Age (years), mean±SD	27.50±6.89	29.64±5.01	0.079
Height (inches), mean±SD	62.83±2.7	62.50±2.8	0.643
Weight (kg), mean±SD	63.9±8.96	64.0±9.93	0.967
ASA grade, *n* (%)			
1	44 (88)	43 (86)	0.766
2	6 (12)	7 (14)	
Total	50	50	

SD: Standard deviation

Figure 3: Intraoperative parameters

	Group I	Group II	P
Time taken to administer the drug in subarachnoid space (s)	29.86±3.02	92.84±13.19	0.001
Number of attempts (%)			
1	48 (96)	42 (84)	0.042
2	2 (4)	8 (16)	
Time to achieve sensory block (T8 level) (min)	4.82±0.64	6.02±0.60	0.000
Time to achieve motor block (Bromage Grade 3) (min)	5.01±0.68	6.59±0.64	0.000

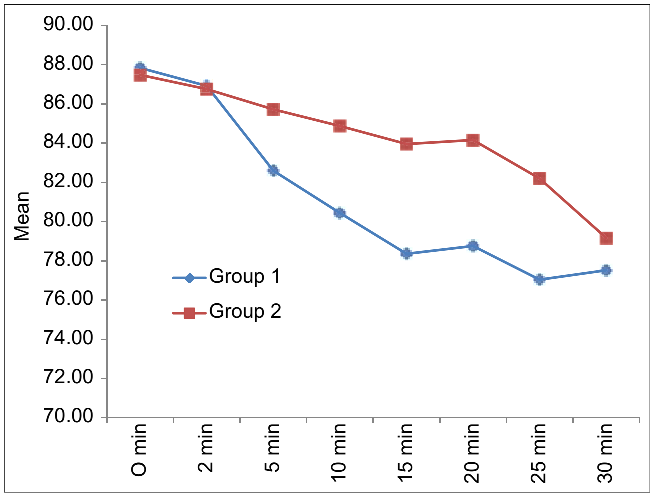

Figure 5: Comparison of mean MAP, MAP: Arterial pressure

spinal anesthesia by the nursing staff who was unknown to the type of needle used for 3 days. The severity of headache was assessed as[9]

- Mild headache that persisted for long hours while sitting and patient doesn't show any symptoms.
- Moderate headache in which the patient could not stay up for more than half an hour and is associated with adverse effects.
- Severe headache occurring on lying in bed and that increased instantly while standing, associated with adverse effects.

PDPH was treated with bed rest, diclofenac 75 mg intravenous (IV) infusion, and plenty of fluids. In refractory cases, an epidural blood patch was given.

2 Backache - Patient was asked about back pain at 24 h, 3rd day, 7th day, 1 month, and 3 months postoperatively either personally or telephonically. The severity of pain was assessed on the Visual Analog Scale (VAS) ranging from 0 to 10 where 0 means no pain and 10 means severe pain. Patients with VAS scale score 0–4 were treated with counselling and mild analgesics whereas patients with VAS score of 5–10 were referred to the orthopedic department for further treatment

3 Any other complication.

Systolic arterial pressure <90 mmHg or a >30% fall in mean arterial pressure was considered as hypotension and was treated

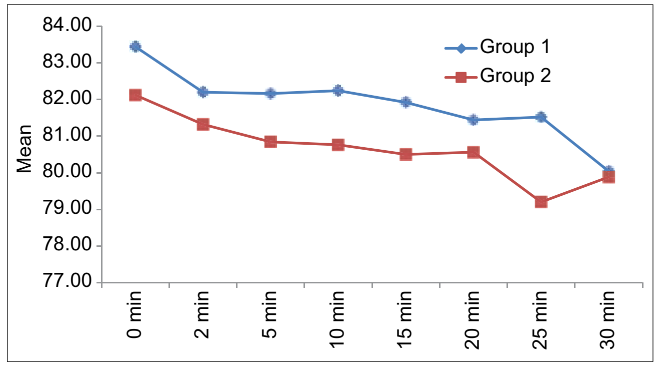

Figure 4: Comparison of mean heart rate

Figure 6: Comparison of occurrence of postdural puncture headache

PDPH	Groups		P
	Group 1	Group 2	
First day	0	0	
Second day	0	0	
Third day	6 (12)	0	0.027

PDPH: Postdural puncture headache

with IV fluids and vasopressors. Bradycardia was defined as heart rate <60 beats/min and was treated with atropine 0.6 mg IV Any other complication if present was noticed and treated accordingly.

Statistical analysis

Data were described in terms of range; mean ± standard deviation, frequencies (number of cases), and relative frequencies (percentages) as appropriate. To determine whether the data were normally distributed, a Kolmogorov–Smirnov test was used. Comparison of quantitative variables between the study groups was done using Student's *t*-test and for independent samples for parametric and nonparametric data respectively. For comparing categorical data, Chi-square (χ^2) test was performed and the exact test was used when the expected frequency was <5. A $P \leq 0.05$ was considered statistically significant. All statistical calculations were done using (Statistical Package for the Social Science) SPSS 21 version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

Results

Both the groups were comparable regarding mean age, weight, height, and ASA status [Figure 2]. The time taken for drug administration in Group 1 was 29.86 ± 3.02 s (secs) and in Group 2 was 92.84 ± 13.19 s. The difference between two groups was statistically significant ($P = 0.001$). With a single attempt, it was possible to give spinal anesthesia for 96% of patients in Group 1 and 84% in Group 2. Two attempts were required in 4% of patients of Group 1 and 16% of patients of Group 2. The difference in number of attempts was statistically significant ($P = 0.042$).

The time taken to attain sensory block up to T8 level in Group 1 was 4.82 ± 0.64 min and 6.02 ± 0.60 min (mins) in Group 2. The motor block was attained at 5.01 ± 0.68 min in Group 1 and 6.59 ± 0.64 min in Group 2. The P value was statistically significant for sensory block ($P = 0.000$) and motor block ($P = 0.000$) [Figure 3].

The changes in mean heart rate and Spo_2 were not statistically significant [Figure 4]. There was statistically significant fall in (MAP) arterial pressure (hypotension) in Group 1 at 5 min, 10 min, 15 min, 20 min and 25 min as compared to Group 2 [Figure 5]. The incidence of bradycardia was statistically insignificant. PDPH occurred in 12% of patients belonging to Group 1 and no patient had PDPH in Group 2. The difference between the two groups was statistically significant ($P = 0.027$). No post-spinal backache was observed in both groups [Figure 6].

Discussion

Spinal anesthesia is the most commonly used type of regional anesthesia, as it is safe, more economical, and easier to use. It also preserves spontaneous respiration, while providing adequate relaxation and analgesia.[10]

An ideal spinal needle should have ease of use, low failure rate must be able to confirm CSF rapidly, lesser delay of local anesthetic injection and must be associated with a lesser incidence of PDPH.[11] Thicker needles are more stable whereas fine Gauge needles are tougher to handle and get deformed easier. In our study, the time for drug administration was significantly higher with 29 G Quincke's spinal needle.

In a similar study done by Lofty Mohammed and El Shal[12] duration for injection of spinal drug administration with 29 G Quincke's spinal needle was 37.4 ± 1.7 s which was much less than our study and it could be due to the less amount (2 ml) of spinal drug used in their study. In another study by Grover *et al*.[13] the time taken to provide spinal anesthesia was significantly longer with 29 G (7.20 ± 3.48 min), which could be due to multiple redirections and attempts taken due to the thin spinal needle. Abdullayev *et al*.[14] in his study concluded, the time taken for induction of spinal anesthesia was <1 min in 73% of patients with 26 G Quincke's spinal needle. Our study showed finer the needle, more is the time required for drug administration. This could be due to increased resistance associated with decreased internal diameter of the needles while injecting the spinal drug.

With single attempt, it was possible to give spinal anesthesia in 96% of patients in Group 1 and 84% of patients in Group 2. No patient required a third attempt. Similar to our study, 85% of patients received spinal anesthesia in single attempt using 26 G Quincke's in the study by Abdullayev *et al*.[14] It was because of better-handling characteristics of the needle and experienced anesthesiologist who performed the procedure. In another study by Tarkkila *et al*.,[15] there were more than 5 attempts with 29 G Quincke's spinal needle in 9% patients. It could be because few obese patients were included in the study and in some case, spinal anesthesia was given without the introducer which increased the number of attempts. In our study, it was possible to perform spinal anesthesia with a single attempt in a greater number of patients because we had included patients mainly of ASA 1 and 2 with no other comorbidities and spine deformities. Furthemore, we had used an introducer to direct the spinal needles. Another reason could be that we had included younger patients with mean age of 27.5 ± 5.01 and 29.64 ± 5.01. In addition, the procedure was performed by well-trained anesthesiologists.

In our study, most of the patients achieved the sensory block up to T8 level in 4.82 ± 0.64 min by 26 G Quincke's while 6.02 ± 0.60 min by 29 G Quincke's with statistically significant P value ($P = 0.00$). Similar to our study, Kaur *et al*.[11] took 5.37 ± 1.73 min to attain sensory block till T8 with 26 G Quincke's spinal needle. The delay in a sensory block on using finer gauge needles was due to increased resistance resulting in more injection time of spinal drug. In addition, Haden *et al*.[16] took 5–7 min to attain sensory block up to T8 with 29 G Quincke's spinal needle.

Motor block of bromage Grade 3 was attained at 5.01 ± 0.68 min for 26 G Quincke's while it was 6.59 ± 0.64 min for 29 G Quincke's with statistically significant $P = 0.000$. On the contrary, in the study by Kaur *et al*.[11] time to achieve motor block till bromage Grade 3 was 12.52 ± 2.69 min for 26G. The time taken to obtain motor block could be due to delay in drug response because of the small diameter needle resulting in slow rate of drug administration. Lesser the rate of drug administration, more laminar the flow and lesser the spread of drug. A flow rate of the drug administration is important as it determines the spread of anesthesia. In other study by Yun *et al*.[17] using 26 G Quincke's time to reach maximum motor block was 19.5 ± 10.5 min for 26 G. 1.6 ml of spinal drug was used and the rate of spinal drug injection was very slow with over 80 s. The changes in mean heart rate and Spo_2 were not statistically significant. There was a significant fall in mean MAP with 26 G Quincke's than with 29 G Quincke's. There was no episode of hypotension at any time interval which required any medical intervention or vasopressor support. Similarly, in the study by Salik *et al*.,[18] hypotension was observed after 10, 15, 30, 40, and 50 min when 26 G Quincke's spinal needle was used and it was profound when needle insertion was in transverse direction. In our study, there was a significant fall in MAP in patients with 26 G Quincke spinal needle. It could be due to transverse insertion of spinal needle.

PDPH occurred in 12% of patients with 26 G Quincke's spinal needle compared to 0% of patients with 29 G Quincke's spinal needle. These patients developed mild PDPH on 3rd day following the procedure. Lofty Mohammed and El Shal[12] also observed incidence of PDPH was 0% in 29G Quincke's in their study. Similarly Omer *et al*.[19] observed a significant reduction of PDPH in parturients receiving spinal anesthesia with 29G spinal needle. In contrast, Grover *et al*.[13] reported an incidence of 4% with 29 G Quincke's needle which was mild in nature and relieved on bed rest. This could be because the number of attempts taken exceeded 4 or more. PDPH is common with large bore needles as the CSF leakage is more. We observed inverse relationship between the incidence of PDPH and needle gauge. We were able to perform spinal anesthesia with maximum of two attempts. The larger the holes and more the attempts, more is the leakage of CSF and more is the time required for repair.

None of the patients developed backache in both the groups. Similar to our study, Salik *et al*.[18] used 26 G Quincke's, and no back pain was seen in any patients. In contrast, Grover *et al*.'s[13] study showed postoperative back pain in 18% and 6% respectively in patients whom 29 G Quincke's spinal needle was used. Multiple attempts were taken in the study and they had not excluded patients with a history of back pain. Our study had no patients with backache in both groups of 26 G and 29 G Quincke's. The back pain is the result of patient positioning on operating table, duration of surgery and due to local irritation caused by spinal needle. We had cared for patient positioning and there were no long duration surgeries included in our study. Furthermore, fine gauge needles are technically more difficult to use which leads to multiple attempts, resulting in increased incidence of backache. Others factors associated with post-spinal backache are high body weight, number of attempts, and bone contacts while giving spinal anesthesia.[8] This study was a single-blinded one as the color coding over the needle made needle size obvious at the time of conducting the procedure.

Conclusion

The use of 29 G Quincke's spinal for spinal anesthesia in young patients led to increased hemodynamic stability, adequate sensory and motor blockade along with no incidence of PDPH and backache. Hence, 29G spinal needle should be used to provide spinal anesthesia in young patients.

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Conflicts of interest

There are no conflicts of interest.

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