Section: Anaesthesia

Original Research Article

COMPARISON OF THE EFFECT OF WHITACRE AND QUINCKE SPINAL NEEDLE ON UNILATERAL SPINAL ANAESTHESIA: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: The objective is to compare the effects of Whitacre and Quincke spinal needles on unilateral distribution of spinal anaesthesia in below knee surgery. **Materials and Methods:** A prospective cohort study was carried out with forty patients scheduled for unilateral below knee surgery under Spinal Anaesthesia. 25-gauge spinal needles were used in both the Whitacre and Quincke groups. After free flow of CSF had been observed, the needle hole was turned towards the dependent side and 8mg of 0.5% hyperbaric bupivacaine was injected. The lateral position was maintained for 15 mins, and then patients were placed in the supine position. Intra-operatively the level of sensory block, motor block, heart rate, systolic and diastolic blood pressure were assessed. Incidence of unilateral sensory and motor block were also assessed after 15mins in the lateral position. **Result:** There was a significant difference in the level of sensory block on the non-dependent side between the two groups starting from the first 5 minutes of injection of local anaesthetic. Patients who had received spinal anaesthesia with Quincke spinal needle had a higher level of sensory block and motor block on the non-dependent side. At all-time intervals the level of sensory block on the non-dependent side in the Whitacre group remained significantly lower (p value < 0.05) than that of the other group. The incidence of unilateral sensory and motor blocks after 15 min in the lateral position was significantly different between the two groups (p<0.05). Our results did not however demonstrate different hemodynamic effects between the groups. **Conclusion:** While both Whitacre and Quincke spinal needles provide sufficient sensory and motor block for lower limb surgeries, the Whitacre spinal needle does provide a more marked unilateral distribution of unilateral spinal anaesthesia. Use of Whitacre spinal needle does avoid unnecessary paralysis of the non-operated side and can be more acceptable for the patient.

INTRODUCTION

Spinal anaesthesia is an easy, rapidly performed and reliable technique and is the most common choice for lower limb surgeries. However, many common adverse effects prevent the more extensive use of spinal anaesthesia such as the high incidence of intraoperative hypotension, postoperative urinary retention and the delay in regaining motor function. Some of these complications can be prevented by preferentially distributing anaesthesia to the operated side only especially in unilateral lower limb surgeries.[1]

Unilateral spinal anaesthesia results in a decrease in the incidence of clinically significant hypotension by up to four-fold, with more stable hemodynamics in comparison to conventional bilateral spinal block.[2] The lack of hypotension makes unilateral spinal anaesthesia suitable for patients with significant cardiovascular diseases e. g. aortic valve stenosis or coronary artery disease. Unilateral spinal anaesthesia can be best obtained by using a directional side port spinal needle like Whitacre,[3] using smaller dose of local anaesthetic,[4] and by positioning the patient in the lateral position for 15–20 min.[5] This technique can result in a small delay in preparation time, but provides less hemodynamic side effects and increased autonomy after surgery with better patient acceptance.

In the setting of this existing background, the present study has been conducted to compare the effects of directional Whitacre and Quincke spinal needle type on the unilateral distribution of spinal anaesthesia in patients undergoing below knee surgery.

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MATERIALS AND METHODS

This prospective cohort study was conducted in the Department of Anaesthesia, Amala Institute of Medical Sciences, Thrissur. The Institutional Ethics Committee approved the study (vide approval no. AIMSIEC/28/2016) for a period of 14 months. The study included forty patients aged 25 to 65 years and belonging to either ASA1 or ASA 2 category (ASA-1- No organic, physiological, biochemical or psychiatric disturbance, ASA-2 -Mild to moderate systemic disturbance) undergoing surgery on one lower limb (e. g., toe, foot, and ankle surgery) under unilateral spinal anaesthesia.

Patients with infection at the site of injection, history of drug allergy to local anaesthetics, coagulopathy and those with marked back arthrosis or scoliosis, diabetes, peripheral neuropathy and patients with neurological deficits were excluded.

Study protocol was explained and written informed consent was obtained from the patient.

The first 20 consecutive patients satisfying the inclusion criteria and in whom the Whitacre needle was used formed the group WG. The first 20 consecutive patients satisfying the inclusion criteria and in whom the Quincke needle was used formed the group QG.

Procedure

All patients were instructed 'nil by mouth' (NPO) for 6 hours prior to surgery and no premedication was given. An intravenous cannula was inserted before initiating spinal anaesthesia. Standard monitoring was used during the study, including non-invasive arterial blood pressure, electrocardiogram and pulse oximetry.

Patients were positioned in the lateral decubitus position with the limb to be operated on the dependent side for the spinal anaesthetic procedure. The lumbar area was prepared aseptically with chlorhexidine and draped. The Dural punctures were performed at either L4-L5 or L3-L4 interspace. 25-gauge spinal needles were used in both Whitacre and Quincke groups. After observing free flow of CSF, the needle hole was turned towards the dependent side and 8mg (1.6 ml) of 0.5% hyperbaric bupivacaine was injected over 30 seconds without further CSF aspiration. The lateral position was maintained for 15 mins, and then patients were placed in the supine position.

Intraoperative monitoring

The sensory level and the vital signs (heart rate, systolic blood pressure and diastolic blood pressure) were recorded at the time of arrival, immediately after spinal injection and at 5 min interval for the first 15 min and thereafter every 10 min for the next 120 mins. Sensory level was defined as the cephalad most dermatome at which the patient had loss of pin prick sensation.

Spinal anaesthesia was termed as unilateral when sensory block was up to or above T12 and modified bromage was >2 on the operative dependent limb with no detectable sensory and motor block on the other limb.

Motor block was assessed and recorded at the time of arrival, immediately after spinal injection and at 5mins interval for the first 15mins, thereafter motor block was assessed only after completion of surgery.

Motor block was assessed using the Modified Bromage scale

0 - No motor block

1- Not able to raise extended legs

2- Not able to flex knees but able to move feet

3- Not able to flex ankle joints

Sensory level was represented numerically for the purpose of statistical analysis

Sensory level	Number
L 5	1
L 4	2
L 3	3
L 2	4
L 1	5
T12	6
T11	7
T10	8
T 9	9
T 8	10
T 7	11

Statistical analysis

Data was coded and entered in Microsoft Excel for Windows 10. The demographic data and hemodynamic changes in both the groups were compared using unpaired t-test. Evolution of sensory block was analysed by using the Mann-Whitney U test. Fisher's exact test was used to analyse the number of patients exhibiting unilateral sensory and motor block. Statistical analysis was performed using SPSS software(version16).

RESULTS

Patients were comparable with regards to age, weight, height and duration of surgery.

No differences were observed between the two groups in terms of heart rate, systolic blood pressure or diastolic blood pressure.

Sensory block

The level of sensory block was expressed as median and was compared at various time intervals. Development of sensory level on the dependent side was similar in both groups.

In the Whitacre group, the highest median sensory level on the dependent side was T10. In the Quincke group, the highest median sensory level was T10 [Table 1].

The highest level of median sensory block on the non-dependent side in the Whitacre group was L4, whereas the highest median level of sensory block on the non-dependent side in the Quincke group was T10 [Table 2].

Motor block

Motor block was also found to be markedly unilateral with higher levels of motor block on the non-

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dependent limb in the Quincke group as compared to Whitacre group ($p<0.05$) [Table 3,4]. This was found to be significant from 10 minutes to 115 minutes.

Incidence of unilateral sensory and motor block

[Table 5] compares the incidence of unilateral sensory and motor block in both the groups. Only six patients were observed to have sensory block on the dependent side with no sensory block on the non-dependent side at 15 minutes in the Whitacre group (6 of 20 patients-30%). Eight patients had motor block on the dependent side with no block on the non-dependent side in the Whitacre group (8 of 20 patients-40%).

The incidence of unilateral sensory block at 15 minutes was 30%, while the incidence of unilateral motor block at 15 minutes was 40% in the Whitacre group.

In the Quincke group, at 15 minutes we observed all patients to have sensory and motor block on both the dependent and non-dependent side. Hence there was no incidence of unilateral sensory block or unilateral motor block in the Quincke group.

The incidence of unilateral sensory and motor blocks after 15 min in the lateral position was significantly different between the two groups ($p<0.05$).

Thirty minutes after patients had been placed in the supine position none of the patients were observed to have unilateral sensory block. Hence there was no incidence of unilateral spinal anaesthesia in either group at 45 minutes.

Table 1: Level of sensory block on the dependent side

Time(in minutes)	Group WG			Group QG			P value (Mann-Whitney U test)
	Median	Min	Max	Median	Min	Max	
0 mins	0	0	0	0	0	0	-
5 mins	4	2	6	4	3	6	0.718
10 mins	6	3	8	5	5	8	0.165
15 mins	8	6	10	7	5	8	0.698
25 mins	8	8	10	8	8	10	1.000
35 mins	8	8	10	8	8	10	0.799
45 mins	8	8	10	8	8	10	0.602
55 mins	8	8	10	8	8	10	0.602
65 mins	8	6	8	8	6	10	0.841
75 mins	8	6	8	7	6	8	0.060
85 mins	6	6	8	6	6	8	0.429
95 mins	6	5	6	6	5	6	0.108
105 mins	5	5	6	5	5	6	0.052
115 mins	5	5	5	5	3	5	0.108
125 mins	5	4	5	4	3	5	0.004

Table 2: Level of sensory block on the non-dependent side.

	Group WG			Group QG			p value (Mann-Whitney U test)
	Median	Min	Max	Median	Min	Max	
on arrival	0		0	0		0	-
5 mins	0	0	1	0	0	3	0.157
10 mins	0	0	1	1	0	4	.002
15 mins	1	0	1	3	1	5	.0001
25 mins	1	1	3	6	3	8	.0001
35 mins	2	1	3	6	5	8	.0001
45 mins	2	1	3	8	5	8	.0001
55 mins	1	1	2	7	5	8	.0001
65 mins	1	1	2	6	5	8	.0001
75 mins	1	0	2	5	4	8	.0001
85 mins	0	0	1	5	3	8	.0001
95 mins	0	0	0	3	3	6	.0001
105 mins	0	0	0	3	1	5	.0001
115 mins	0	0	0	1	1	3	.0001
125 mins	0	0	0	1	0	3	.0001

Table 3: Motor block on the dependent side

	Group WG		Group QG		p value(Mann-Whitney U test)
	Median	Min-max	Median	Min-max	
on arrival	0	0	0	0	-
0 mins	0	0	0	0	-
5 mins	2	1-3	2	1-2	0.165
10 mins	2	2-3	2	2-3	0.602
15 mins	3	3-3	3	3-3	1.000
95 mins	3	2-3	3	2-3	0.799
105 mins	3	2-3	2	2-3	0.130
115 mins	2	2-3	2	2-3	0.183
125 mins	2	1-2	2	1-2	0.183

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Table 4: Motor block on the non-dependent side

	Group WG		Group QG		p value(Mann-Whitney U test)
	Median	Min-max	Median	Min-max	
on arrival	0	0	0	0	-
0 mins	0	0	0	0	-
5 mins	0	0	0	0-1	0.183
10 mins	0	0	2	1-2	0.0001
15 mins	0	0-1	3	2-3	0.0001
95 mins	0	0	1	0-2	0.0001
105 mins	0	0	1	0-2	0.0001
115 mins	0	0	1	0-1	0.006
125 mins	0	0	0	0-1	0.429

Table 5: Incidence of unilateral sensory and motor block

		Group WG	Group QG	P value (fisher's exact test)
Incidence of unilateral sensory block at 15 minutes	No	14	20	.002
	Yes	6	0	
Incidence of unilateral motor block at 15 minutes	No	12	20	0.0001
	Yes	8	0	

DISCUSSION

Conventional dose spinal anaesthesia may not be suitable for use in those with cardiovascular disease or in the elderly, and anaesthetists need to familiarise themselves with techniques that are associated with hemodynamic stability and a rapid recovery profile.[6,7] Unilateral spinal anaesthesia aims to limit the distribution of spinal block to the operated side,[8] with the favourable effect of minimizing the cardiovascular effects of spinal block.[5] Therefore, it Is the preferred anaesthetic technique in operations involving a single extremity.[9] The aims of limiting the spread of a spinal block are two. First, restricting the block mostly to one side, can help in minimizing the effects of sympathetic blockade to reduce the cardiovascular side-effects of an extensive block[10,11] and second, smaller doses of hyperbaric bupivacaine can help optimize the recovery profile of a spinal block to achieve earlier patient mobilization.[10,12,13]

In the present study we have compared the effects of Whitacre and Quincke needles on the distribution of unilateral spinal anaesthesia. No differences were observed between the two groups in maximal sensory level on the dependent side and time to reach it. There was a significant difference in the level of sensory block on the non-dependent side between the two groups starting from the first 5 minutes of injection of local anaesthetic. Patients who had received spinal anaesthesia with Quincke needle had a higher level of sensory block and motor block on the non-dependent side. At all-time intervals the level of sensory block on the non-dependent side in the Whitacre group remained significantly lower (p value < 0.05) than that of the Quincke group.

Andrea Casati, Guido Fanelli and colleagues conducted a prospective, randomized, double-blind study to compare the effects of the Whitacre and Quincke spinal needles on the unilateral distribution of spinal block. 8 mg (1.6 ml) of 0.5% Hyperbaric bupivacaine was injected at a rate of 0.05 ml/sec in both the Whitacre group and the Quincke group in 30 patients. Unilateral sensory block was observed in 10 patients in the Whitacre group (66%) and in only 2 patients in the Quincke group (13%) ($p < 0.05$). Motor block was preferentially more unilateral in the Whitacre than in the Quincke group. Patients in the Quincke group were also found to have higher sensory levels on the nondependent side than those in the Whitacre group.

Although a more marked unilateral distribution of spinal anaesthesia was observed in the Whitacre group versus the Quincke group, our results did not demonstrate patients with strictly unilateral anaesthesia in either group. These differences may be partly due to differences in the rate of injection (0.05ml/sec) of local anaesthetic which was done manually, as injection rate does influence the spread of local anaesthetic.[14]

Kristiina S. Kuusniemi et al conducted a prospective, randomized, double-blind study to evaluate the effects of Whitacre and Quincke spinal needle on the unilateral distribution of the local anaesthetic. 60 outpatients scheduled for unilateral lower-limb surgery were randomized to receive spinal anaesthesia using either a 27-G Whitacre or a Quincke needle. They concluded that Whitacre needle did produce a more markedly unilateral block as compared to Quincke but there were no incidences of strictly unilateral anaesthesia in either group. Therefore, their findings corroborate well with the results of this study

The results of the present study confirm that the choice of a directional spinal needle is important when attempting unilateral spinal anaesthesia. Unlike Quincke point needles, injection through a Whitacre needle results in streaming and directional flow in the direction of the needle hole, whereas the use of a slow injection speed provides a laminar flow, which minimizes the mixing of hyperbaric bupivacaine with the CSF and improves the unilateral distribution of spinal anaesthesia.

Several studies have shown the usefulness of unilateral block in preventing hypotension (5), Casati A, Fanelli conducted a randomised double-blind study to evaluate the incidence of hypotension during

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unilateral spinal anaesthesia The incidence of hypotension was higher in the conventional group (22.4%) than unilateral group (5%). They concluded that unilateral spinal anaesthesia with a Whitacre needle reduces the incidence of hypotension during spinal anaesthesia.[2]

Our results did not however demonstrate different hemodynamic effects. The expected small hemodynamic changes in unilateral block may be more relevant in elderly and chronically ill patients,[9] and further controlled studies should be performed to evaluate the usefulness of unilateral spinal anaesthesia in high risks patients.

CONCLUSION

We conclude that when a small dose of 0.5% hyperbaric bupivacaine is injected slowly into patients in the lateral position for 15 min, both Whitacre and Quincke spinal needles provide sufficient block for lower limb surgery but the Whitacre spinal needle provides a more marked differential block of sensory nerve roots between dependent and nondependent sides compared with the Quincke needle.

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