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Evaluation of Vibration Sense and Motor Power Following Epidural Anaesthesia

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Abstract

Background: It is very important to see complete recovery from regional anaesthesia before ambulation and discharge of the patient. Bromage score or the Formal motor power test system are the conventional methods which have been used to see recovery from epidural block. *Material and Methods*: A total of fifty patients of ASA grade I and II, presenting for surgeries below the umbilicus under epidural anesthesia were taken up for the study. The block recovery was compared with the use of a 128-Hz tuning fork with the conventional tests. Conventional block recovery testing included Bromage score, Formal muscle power testing according to the British Medical Research Council, pinprick testing, and warm/cold testing. After obtaining base line values, an epidural block was performed and patients were tested every 15 minutes after surgery, till the vibration score of one less than the baseline was achieved. The results of the different methods to the time at which baseline values of vibration sense were reached were compared. *Results*: At the end of surgery, normal baseline power, foot flexion and foot extension strength was attained in all the 50(100%) patients at 90-100 minutes where as complete recovery of quadriceps strength was seen in 45 (90%) patients, rest of the patients with residual muscle weakness had motor power of grade IV and normal motor power Grade V was achieved in the next 10 minutes. *Conclusion*: Recovery of vibration sense corresponds with recovery of motor block after epidural anesthesia and may serve as an easy means of documenting recovery with a single test before discharge.

Keywords: Ambulation; Epidural Anaesthesia; Tuning Fork.

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Introduction

Central neuraxial block (subarachnoid, epidural, caudal block) may be used alone or in conjunction with general anaesthesia for any surgery below the neck. Local anesthetics block various nerve fibers after central neuraxial blockade. Autonomic preganglionic B fibres are the first to be blocked followed by fibres conveying temperature (cold before warm), pinprick, pain, touch, deep pressure and motor. Recovery from the blockade occurs roughly in the reverse order [1]. In any case, resolution of motor blockade should occur when vibration sense returns to the baseline after neuraxial blockade. The testing of recovery from neuraxial block use different types of motor power tests like Bromage score [2] or the Formal motor power test system of the British Medical Research

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Council. The immobilizing dressings from the surgical procedures or associated pains make it difficult to perform these tests.

The benefit of using an epidural blockade is the gradual onset of block and early mobility in the postoperative period. Early return of motor function with epidural analgesia, leads to false sense of security to walk but actually, patient may fall due to poor coordination of lower limbs because of inadequate posterior column sensations. So, it is very important to see complete recovery following neuraxial blockade for early ambulation and discharge of the patient.

To ensure safe walking after epidural anaesthesia, patient should have adequate muscle power and proprioception. Assessment of vibration sensation is easier than assessment of sensory perception and motor power. Traditionally, the non-graduated tuning fork was used for the evaluation of vibration sense, but unfortunately, it does not estimate the degree of dysfunction quantitavely [3]. A 128 Hz Rydel-Seiffer graduated tuning fork fulfils all the needs in providing an ideal instrument and is reliable for quantifying the impairment of vibration sense [4]. Hence, our prospective study endeavored to evaluate if vibration sensation could be used as an indicator of motor power in patients after surgery under epidural anaesthesia.

Materials and methods

After approval from institutional ethics committee (IEC), this prospective study was conducted on a total of 50 adult patients aged 18 to 45 years with ASA physical status I and II presenting for surgeries below the umbilicus under epidural anaesthesia. Patients with contraindication to epidural anesthesia, peripheral neuropathy and injury of the lower limbs were excluded from the study. A written informed consent was taken from all the patients.

A thorough pre-anaesthetic evaluation was conducted prior to surgery. Base line vibration sense score was recorded using 128 Hz Rydel Seiffer's tuning fork. It has calibrated weights at the extremities of its arms which has a triangle with an arbitrary scale from 0 to 8. When the tuning fork vibrates, weights appear double and two virtual triangles appears. Their intersection point moves upward with decreasing amplitude of arms. Patient was instructed to inform as soon as he felt no vibration and the score visible at that time was considered as the nearest value to the apparent point of intersection of the virtual triangle. Vibration sense was tested two times at each measurement at terminal inter-phalengeal joint of great toe and medial malleolus and was calculated as mean. Motor power of quardriceps muscle, foot flexion and foot extension (according to modified grading system of formal motor power testing, British Medical Council, 1978) was recorded. In the OR, monitoring of heart rate, noninvasive blood pressure, respiratory rate, ECG and Spo_2 was started. Intravenous line was placed and Ringer lactate 10 ml/kg body weight was given over a period of 20 minutes.

Under strict aseptic conditions, a single dose epidural block was performed in sitting position at level of L2-L3/L3-L4 intervertebral space using 18 G Touhy needle. After waiting for three minute following 3 ml of test dose, 1.5% Lignocaine with 1:2,00,000 adrenaline, 5 mg/kg body weight of the drug was injected through the epidural catheter. Heart rate, noninvasive blood pressure, respiratory rate and Spo_2 were recorded. After placement of the drug in epidural space, assessment of vibration score, formal motor power score, Bromage score was recorded every 10 minutes till vibration score of 2 was reached. After that reading was taken every 5 minutes till the Bromage score of 3 and vibration sense score of 0 was attained (onset of epidural anaesthesia). The surgery was allowed to proceed. Immediately after completion of surgery, vibration score, Bromage score and formal motor power of quadriceps muscle, foot flexion and foot extension was recorded every 15 minutes, till the vibration score one less than the base line value is achieved. After that the readings were taken at an interval of 5 minutes. Motor power was assessed till all the parameters reach baseline value.

Statistical analysis

All the results were tabulated and analyzed using Kruskal–Wallis test followed by Mann–Whitney U-test. $p < 0.05$ was considered to be significant.

Results

The correlation between the loss of vibration sense and motor blockade at time of onset of epidural block was studied. The r-value (coefficient of correlation) is significant at all time intervals (Table 1) (100%) was achieved in all the 50 cases. At the end of surgery, normal baseline power, foot flexion and foot extension strength was attained in all the 50 (100%) patients at 90-100 minutes where as complete recovery of quadriceps strength was seen in 45 (90%) patients, rest of the patients with

residual muscle weakness had motor power of grade IV and normal motor power Grade V was achieved in the next 10 minutes (Table 2).

Vibration sense recovery with respect to other parameters i.e. Bromage score, quadriceps strength, foot flexion strength, foot extension strength was compared using Z test (Z = 2.29) which is statistically significant. (Table 3).

Table 1: Motor Power Assessment at Time Vibration Score Became 0 (Onset of Block)

Parameters	Motor Score	No. of Patients	Percentage	Z value	P value
Bromage score	3	50	100.00	0	>0.10
Quadriceps strength	0	50	100.00	0	>0.10
Foot flexion strength	0	50	100.00	0	>0.10
Foot extension strength	0	50	100.00	0	>0.10

Table 2: Relationship between Vibration Sense with Bromage Score, Quadriceps Strength, Foot Flexion Strength and Foot Extension Strength at Recovery

Time in minutes	Vibration Score	Bromage Score			Quadriceps Strength			Foot flexion strength			Foot extension strength		
	Mean ± SD	Mean ± SD	r value	p value	Mean ± SD	r value	p value	Mean ± SD	r value	p value	Mean ± SD	r value	p value
0	3.08±2.63	1.9±1.08	-0.783	<0.01	2.08±1.95	0.771	<0.01	2.19±2.00	0.801	<0.01	2.19±2.00	0.801	<0.01
15	2.58±2.25	2.03±0.98	-0.884	<0.01	2.00±1.81	0.859	<0.01	1.88±1.80	0.876	<0.01	1.88±1.80	0.876	<0.01
30	3.82±2.47	1.54±1.29	-0.877	<0.01	2.40±2.35	0.761	<0.01	2.36±2.36	0.767	<0.01	2.36±2.36	0.767	<0.01
45	3.4±2.44	2.00±0.88	-0.682	<0.01	2.230±1.79	0.729	<0.01	2.170±1.8	0.674	<0.01	2.250±1.8	0.653	<0.01
60	4.2±2.2	1.40±1.26	-0.830	<0.01	2.89±1.69	0.925	<0.01	2.75±1.75	0.923	<0.01	2.75±1.75	0.923	<0.01
75	4±2.45	1.80±0.84	-0.976	<0.01	2.33±1.15	1.00	<0.01	2.33±1.15	1.000	<0.01	2.33±1.5	1.000	<0.01
90	5.33±1.15	1.33±0.58	-1.000	<0.01	3.00±1.41	1.000	>0.10	3.00±1.41	1.000	<0.01	5.00±1.41	-1.000	<0.01
100	-	-	-	-	-	-	-	-	-	-	-	-	-
05	6.3±0.57	0.57±0.75	-0.158	>0.10	4.39±0.78	0.007	>0.10	4.44±0.81	0.140	>0.10	4.44±0.81	0.140	>0.10
10	7.05±0.89	0.45±0.57	0.357	<0.05	4.70±0.57	0.164	>0.10	4.90±0.32	0.00	>0.10	4.90±0.32	0.000	>0.10
15	-	-	-	-	-	-	-	-	-	-	-	-	-

(* After vibration score had reached 2, observations were made at interval of 5 minutes).

Table 3: Motor Power Assessment at Time Vibration Score Returned to Baseline Value (Recovery)

Parameters	Motor Score	No. of patients	Percentage	Z value	p value
Bromage score	0	50	100.00	0	>0.10
Quadriceps strength	5	45	90.00	2.29	<0.05
Foot flexion strength	5	50	100.00	0	>0.10
Foot extension strength	5	50	100.00	0	>0.10

Fig. 1: 128 Hz Rydel–Seiffer Tuning Fork (source: www.tuning-fork.info)

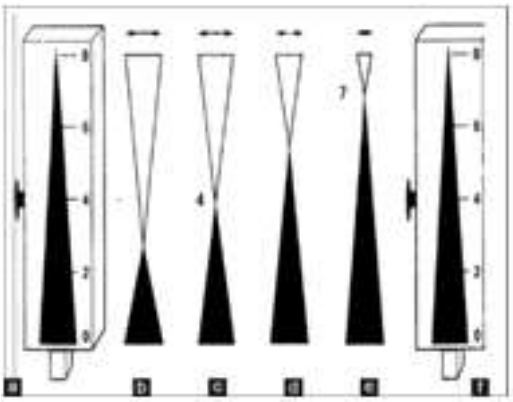

Fig. 2: Extremities of the tuning fork at rest (a) and during vibration (b-f). Intersection between lower and upper triangles moves from 0 (minimum score) to 8 (maximum score) with decreasing amplitude. (Source: www.neurology.org)

Table 4: Modified grading system for formal motor power testing (British Medical Research Council, 1978).

Grade	Description
0	No muscle contraction at all
1	Visible muscle contraction, but no movement
2	Movement without influence of gravity
3	Movement against gravity
4	Movement against resistance
5	Normal strength

Discussion

In the time of ERAS (enhanced recovery after surgery), early ambulation is recommended in the postoperative period. However a complete motor recovery and maintenance of accurate balance is a prerogative this. There is some controversy as to whether motor neurons and vibration sense fibers are blocked to the same degree [4] or if afferent fibers are even more sensitive to local anesthetics because of a higher baseline discharge rate [5]. The relation among motor function, balance and postural stability is complicated. Sensory inputs from visual, somatosensory and vestibular inputs by the brainstem and cerebellum are required to maintain balance [6]. The brain analyses this sensory information and controls body position [7]. Evaluation of these indicators is subjective, potentially resulting in variable definitions of return of motor function, making it difficult to predict full recovery. Many studies have evaluated the order of blockade of various sensations taking only sensory perception and motor strength as criteria, but assessment of order of blockade using vibration sense following epidural anaesthesia has been studied are limited. In our study we assessed the efficacy of vibration sense along with motor power to know the onset and recovery of epidural block and studied the correlation between them. At onset of epidural block in all the 50 patients, when vibration sense score had reached 0, Bromage score of 3 and motor power of quadriceps, foot flexion and foot extension were attained. The positive correlation between loss of vibration sense with motor block at the onset of epidural block was found. We also evaluated vibration sense and motor power at recovery of block. At the time vibration score returned to baseline value, Bromage score of 0, foot flexion strength and foot extension strength of 5 was attained in all 50 patients. The complete recovery of quadriceps strength was recorded in 90% (45 out of 50) of patients and its difference with respect to vibration sense recovery was statistically significant ($p < 0.05$). 10% of patients (5 out of 50) showed motor weakness of grade IV which returned to baseline i.e. grade V in the next 10-15 minutes.

Vibration sense testing was used to determine recovery from epidural block, in patients undergoing lower segment caesarean delivery or vein stripping. Sebastian found that recovery of vibration sense corresponded with recovery of motor block and could be used as a single test before discharge [8]. Abrahams M [9] used dorsal column sensory function including vibration sense, distal proprioception and the Romberg test primigravidae for labor epidural analgesia before epidural catheter insertion. On addition of 100 µg fentanyl to 15 mg of bupivacaine gave good control of labour pain with no motor block along with preservation of dorsal column sensory function. In another study, on parturients given labour analgesia incidence of motor weakness was same [10]. The evaluation of dorsal column functions after epidural and spinal blockade and its implications for safety of walking following low dose regional analgesia for labour was done. It was found that abnormal dorsal column functions increase with increasing motor block. Thus this study emphasized that both lower limb motor power and dorsal column function should be assessed and shown to be normal before allowing patients to walk at any point.

Recovery of vibration sense has been shown to correspond with recovery of motor block after spinal anesthesia and may serve as an easy means of documenting recovery with a single test before discharge [12]. Al metwalli [13], used quantitative measurements of the degree of recovery of the motor power of the knee, hip, or ankle flexors and found them to be more accurate and superior to Bromage score ($p< 0.001$), as predictors of patient's ability to safely ambulate after spinal anesthesia. testing with 128 Hz Rydel–Seiffer tuning fork along with motor power assessment has also been used as an objective tool to assess the onset of surgical anesthesia following brachial plexus block.In another study alongwith assessing the motor blockade, vibration sense was tested to determine the onset of surgical anaesthesia. They found it to be a reliable indicator in patients given supraclavicular brachial plexus bock [14].

From our study we concluded that vibration sense testing with Rydel Seiffer tuning fork along with motor power assessment may be used a tool to know the onset of epidural block. Vibration sense testing can be used to document recovery from epidural block. When the vibration sense returned to baseline value, all the baseline motor power parameters were achieved except for some motor weakness in quadriceps muscle (grade IV) which took 10-15 minutes more time to achieve baseline value. So we recommend that we should

wait for a minimum of 15 minutes (may vary for different drugs) or more after vibration sense has returned to baseline value to have normal motor power for ambulation of the patient. It may serve as a reliable method, for motor recovery, assessment in cases where there is difficulty in assessing the motor power.

Hence after epidural block, vibration sense along with motor power assessment may be used as an objective tool to assess whether the block is recovered and discharge maybe done.

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