

# Evaluation of the olfactory memory after spinal anesthesia: a pilot study

A. DEMIRHAN<sup>1</sup>, K. ERDEM<sup>2</sup>, A. AKKAYA<sup>1</sup>, U.Y. TEKELIOGLU<sup>1</sup>, M. BILGI<sup>1</sup>,  
C. ISIK<sup>3</sup>, M. SIT<sup>4</sup>, U. GOK<sup>5</sup>, H. KOCOGLU<sup>6</sup>

<sup>1</sup>Department of Anesthesiology and Reanimation; <sup>2</sup>Department of Cardiovascular Surgery; <sup>3</sup>Department of Orthopedics and Traumatology; <sup>4</sup>Department of General Surgery; <sup>5</sup>Department of Otorhinolaryngology; <sup>6</sup>Department of Anesthesiology and Reanimation, Abant Izzet Baysal University Medical School, Bolu, Turkey

**Abstract. – BACKGROUND:** The aim of this study was to investigate the effect of spinal anesthesia (SA) on olfactory memory using Brief-Smell Identification Test™ (B-SIT).

**PATIENTS AND METHODS:** This, prospective, clinical study was performed on 40 ASA physical status I-III patients, between 18-65 years of age undergoing a planned elective minor surgery under SA. All participants were preoperatively informed about B-SIT and the mode of application of the test according to the information in the book. B-SIT was applied to each patient preoperatively and the scores were recorded. B-SIT was reapplied to all patients on the 1st and 2nd postoperative days and the scores were recorded. Moreover, development of postdural puncture headache (PDPH) and/or neurological symptoms (such as hearing loss, diplopia) were checked.

**RESULTS:** Postoperative headache was observed in 7 of the participants and 3 of them was diagnosed to have PDPH. No statistically significant difference was observed in the olfactory memory evaluation of the patients suffering from headache and the 3 patients diagnosed with PDPH. No statistically significant difference was observed in the correct odor answer ratio between the preoperative and postoperative 1st and 2nd days ( $p > 0.05$ )

**CONCLUSIONS:** We confirm that SA does not affect olfactory memory. Further studies are necessary to confirm the results of our pilot study in a larger sample.

*Key Words:*

Spinal anesthesia, Olfactory, Memory.

## Introduction

Spinal anesthesia (SA) is a widely used regional anesthesia (RA) technique. Although it presents many advantages compared to general anesthesia<sup>1</sup>, it also has some rare but severe complications (cardiac arrest, meningitis, spinal hematoma, cranial

nerve paralysis)<sup>2</sup>. The prevalence of cranial nerve paralysis after a SA varies between 1:300 and 1:8000<sup>3</sup>. However, with the evolution of technology today, spinal needle design has changed and, thus, has permitted a reduction in complications associated to spinal anesthesia<sup>4</sup>. As it has a long course in the head, abducens nerve is the most frequently affected nerve pair<sup>5,6</sup>, while many other nerve pairs affected in the head and leading to neurological symptoms have been described in literature<sup>7-9</sup>. The mechanism of injury is explained as that the decrease of intracranial pressure due to the loss of cerebrospinal liquid after lumbar puncture (LP) affects intracranial structures and nerves<sup>10</sup>. Intracranial olfactory pathways are constituted of structures such as olfactory bulb, olfactory tract, olfactory stria and olfactory tubercle; these transmit olfactory impulses to odor centers<sup>11</sup>. As far as we know, there is no study in literature about the effect of SA on olfactory memory. Our objective is to study the effect of SA on olfactory memory using Brief-Smell Identification Test™ (B-SIT).

## Patients and Methods

Ethical approval for the study was provided by the Clinical Research Ethical Committee of Abant Izzet Baysal University, Bolu, Turkey (Ethical Committee No: 2012/233). This study was conducted in accordance with the ethical principles described by the Declaration of Helsinki and all participants provided a written informed consent. This, prospective, clinical study was performed on 40 ASA physical status I-III patients, between 18-65 years of age undergoing a planned elective minor surgery under SA. Patients having structural and infectious diseases in nose (septum deviation, polyp, and rhinitis), smokers, patients with congenital, neurological, endocrine, psychiatric,

and chronic inflammatory diseases (syphilis, tuberculosis, diabetes mellitus, Parkinson disease) were excluded from the study. Patients with metabolic diseases, alcohol and drug addicts were accepted as drug-consuming patients.

B-SIT is widely used in the evaluation of olfactory functions<sup>12</sup>. The test consists of a small book which includes 12 different odorants which are released when scrabbled with the tip of a pencil. For each question, there are four different choices and only one correct answer, and one of the choices needs to be selected. If the odorant smelled is not identified among the choices or if there is no presumption, one of the answers should be selected<sup>13</sup>.

All participants were preoperatively informed about B-SIT and the mode of application of the test according to the information in the book. B-SIT was applied to each patient preoperatively and the scores were recorded. Patients who developed common cold, sinus problems and infection in the postoperative period were excluded from the study.

After establishing vascular access to the patient in the surgery room, all patients were premedicated with 0.03 mg/kg i.v. midazolam. Standard monitorization was performed using non-invasive blood pressure monitoring, pulse oximetry and electrocardiogram. Before SA, intravenous (i.v.) with 6 ml/kg/h 0.9% NaCl was given to all patients. Spinal anesthesia was performed using a 25-gauge Quincke spinal needle (Braun Melsungen, Germany), while the patient is in the sitting position, through the L3-4 interspace (or alternatively through the L4-5 interspaces). 3.5 mL of 0.5% marcaine heavy (Marcaine Spinal Heavy Ampul 0.5%, Astrazeneca) was administered to the subarachnoid space. During surgery, 4 ml/kg/h i.v infusion was continuously administered. Oxygen was delivered to all patients at a rate of 3 L/min via a nasal cannula. Level of sensorial blockade was evaluated by pinprick test and then recorded. Non-invasive blood pressure measurements were obtained from each patient at 5 min intervals. We assumed a systolic blood pressure <90 mmHg or >20% decrease in systolic blood pressure as hypotension. We treated hypotension by increasing the infusion rate of normal saline, and administering 5-10 mg of intravenous ephedrine (Ephedrine Amp. 1 ml/50 mg, Osel) in necessary cases. In the postoperative first 24 hours, a total of 2000 ml of Isolyte-S (Eczacibasi-Baxter, Istanbul, Turkey) electrolyte solution was administered. B-SIT was reapplied to all patients on the 1<sup>st</sup> and 2<sup>nd</sup> postoperative days and the scores were recorded. Moreover, development of post-

dural puncture headache (PDPH) and/or neurological symptoms (such as hearing loss, diplopia) were checked.

### Statistical Analysis

Data analysis was performed using Statistical Package for Social Science (SPSS Inc., Chicago, IL, USA) for Windows software. In the descriptive statistics, variables with continuous measurements (for example: age, OAB, etc.) were expressed as mean  $\pm$  standard deviation, while case number (%) was preferred for categorical variables (for example: B-SIT scores, etc.). Paired-Samples *t* test was used for the comparison of the averages of repetitive continuous variables. The significance of the difference between categorical variables was analyzed using Pearson's Chi-Square test. *p* value <0.05 was considered as statistically significant.

## Results

40 volunteers were prospectively included in the study. The demographic and clinical characteristics are given in Table I. When compared to preoperative baseline mean arterial pressure (MAP) values, the MAP values obtained during the intraoperative period were statistically lower (*p* < 0.05) (Table II). Hypotension was detected in 6 patients during the intraoperative period and ephedrine was administered.

Evaluation of the olfactory memory was established by using B-SIT test on postoperative 1<sup>st</sup> and 2<sup>nd</sup> days using the preoperative test results as the baseline. No statistically significant difference was observed in the correct odor answer ratio between the preoperative and postoperative 1<sup>st</sup> and

**Table I.** Demographics and clinical characteristics of the patients.

Number of patients (n)	40
Age (yr)	32.7 $\pm$ 13.9
Gender	
Male	32 (80.0%)
Female	8 (20.0%)
Body mass index (kg/m <sup>2</sup> )	25.0 $\pm$ 5.5
Maximum sensory block (thoracic)	6.3 $\pm$ 1.5
Efedrine necessity due to hypotension	6 (15%)
Duration of surgery (min)	62.5 $\pm$ 37.0
Frequency of postoperative headache	7 (17.5%)

Values are expressed as mean (SD) or n (%)

**Table II.** The intraoperative mean arterial pressure levels in different time points.

	Baseline	5 min PI	10 min PI	15 min PI	20 min PI
MAP	98.7 ± 12.5	93.6 ± 12.6 <sup>a</sup>	88.5 ± 13.9 <sup>b</sup>	89.4 ± 13.6 <sup>b</sup>	89.0 ± 11.4 <sup>b</sup>
<i>p</i> value	= 0.07		< 0.001		

<sup>a</sup>There was a statistically significant difference between baseline and 5 min after PI: post intubation ( $p = 0.07$ ),

<sup>b</sup>There was a statistically significant difference between baseline and 10, 15, 20 min after PI: post intubation ( $p < 0.001$ ),

2<sup>nd</sup> days ( $p > 0.05$ ) (Table III). Postoperative headache was observed in 7 of the participants and 3 of them was diagnosed to have PDPH. No statistically significant difference was observed in the olfactory memory evaluation of the patients suffering from headache and the 3 patients diagnosed with PDPH ( $p > 0.05$ ).

## Discussion

Olfactory memory is quite important for people. It presents many advantages such as the recognition of food and drinks as well as the detection of environmental danger and support the quality of life. The olfactory receptors of the nose, the somatosensory fibers of the fifth cranial nerve, and many regions of the brain such as the olfactory bulb, anterior olfactory nucleus, olfactory stria and the prepiriform cortex are implied in smelling<sup>14</sup>. Moreover, the relation of the olfactory system with the trigeminal system helps the detection of odors<sup>15</sup>. Alteration of such a complex

structure may lead to olfactory dysfunction. Lesions in the nose, infections, neurological disorders, utilization of alcohol and drugs may lead to olfactory dysfunction as mentioned in literature<sup>11,16</sup>. In addition, the observation of olfactory dysfunction in approximately 5% of the population<sup>17</sup> makes the evaluation of olfactory memory difficult. In the present study, we have found that olfactory memory is not affected by SA performed by using spinal marcaine heavy.

Many tests have been used for the evaluation of olfactory function until now<sup>16</sup>. The evaluation of olfactory functions of the patients based on recognition of the odor in odor identification test is the most important part<sup>16</sup>. Among these tests, 12-odor containing Brief-Smell Identification Test<sup>TM</sup> (B-SIT; also known as the Cross-Cultural Smell Identification Test<sup>TM</sup>)<sup>18</sup> has been prepared and used taking into consideration cultural differences<sup>16</sup>. In a study, Double et al<sup>19</sup> have determined B-SIT sensitivity and specificity as 82%. In our study, we used the factors responsible from olfactory dysfunction to exclude the patients. Moreover, we

**Table III.** The correct item identification rates in BSI test scores preoperatively and 1st and 2nd days postoperatively.

Item No	Odor	Preoperative n (%)	Postoperative day 1 n (%)	Postoperative day 2 n (%)	<i>p</i> value
1	Mint	38 (95%)	39 (97.5%)	38 (95%)	$p > 0.05$
2	Banana	38 (95%)	38 (95%)	38 (95%)	
3	Clove	40 (100%)	38 (95%)	38 (95%)	
4	Leather	29 (72.5%)	30 (75%)	31 (77.5%)	
5	Strawberry	31 (77.5%)	32 (80%)	34 (85%)	
6	Pine	38 (95%)	38 (95%)	38 (95%)	
7	Cinnamon	35 (87.5%)	37 (92.5%)	37 (92.5%)	
8	Soot	39 (97.5%)	39 (97.5%)	39 (97.5%)	
9	Lemon	31 (77.4%)	33 (82.5%)	32 (80%)	
10	Soap	39 (97.5%)	39 (97.5%)	40 (100%)	
11	Baby powder	38 (95%)	39 (97.5%)	39 (97.5%)	
12	Rose	31 (77.5%)	29 (72.5%)	31 (77.5%)	
Total	Correct identification	427 (88.9%)	431 (89.7%)	435 (90.6%)	

Values are expressed as numbers (%) of patients

used the Turkish version of B-SIT test, thus allowing appropriate odor evaluation.

It has been declared in literature that general anesthesia affects the olfactory memory<sup>20-23</sup>. The cranial nerve pairs are affected by SA<sup>2,24,25</sup>, and this has been proposed to be associated to cerebrospinal liquid loss and intracranial hypotension after lumbar puncture (LP)<sup>10,26</sup>. PDPH was reported to occur at a prevalence of 1% in association with LP applied during SA<sup>4</sup>, and symptoms of PDPH and cranial nerve paralysis were reported to be seen together after LP<sup>2,27</sup>. In 7 of our patients, headache developed within the postoperative 36-48 hours. For 3 of these, a diagnosis of PDPH was established. No neurological sign (such as hearing loss, vertigo, tinnitus) was observed associated to headache. While headache was treated using liquid resuscitation and medical treatment and disappeared within 24 hours, an epidural patch was applied to one patient. The olfactory memory evaluations of these patients were normal. De Lange et al<sup>28</sup> proposed that intraoperative severe hypotension (60/40 mmHg) that develops secondary to SA and lasts for 15 minutes affects the optic nerve and leads to visual disturbance. The intraoperative MAP values obtained in our study were low compared to the preoperative values. We considered this as an expected cardiovascular situation during SA. Ephedrine was administered to six of our patients according to the criteria of our work and hypotension was rapidly corrected. The olfactory memory of these patients was not affected.

## Conclusions

We have observed that SA does not affect olfactory memory. Further studies are necessary to confirm the results of our pilot study in a larger sample.

## Conflict of Interest

The Authors declare that there are no conflicts of interest.

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