DOI: *http://dx.doi.org/10.22122/ahj.v12i1.257* *Published by Vesnu Publication*

Cerebrospinal Fluid and Spinal Anesthesia Parameters in Healthy Individuals versus Opium-addict Patients during Lower Limb Surgery

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Original Article

Abstract

Background: Studies have reported lower pain threshold, spinal anesthesia duration, and level of sensory block in addicts compared to non-addict patients undergoing spinal anesthesia for surgery. Moreover, blood gas and cerebrospinal fluid (CSF) were likely to be affected as well. The aim in the present study is to evaluate CSF and spinal parameters in addict versus non-addict patients during lower limb surgery.

Methods: In this case-control study, 22 opium addicts and 22 sex- and age- matched non-addicts undergoing lower limb surgery under spinal anesthesia were included. The CSF parameters, venous blood gas (VBG), and sensory and motor block findings were compared between the groups.

Findings: The addict and non-addict patients were similar regarding CSF and blood gas parameters except higher pH in VBG (7.39 ± 0.06 vs. 7.33 ± 0.11, P = 0.030) and CSF (7.39 ± 0.06 vs. 7.33 ± 0.11, P = 0.030) for addict patients. The addict patients had significantly later onset of sensory block (5.72 ± 1.57 vs. 3.16 ± 0.93 minutes, P < 0.001) and shorter motor block duration (137.72 ± 11.51 vs. 149.09 ± 14.44 minutes, P = 0.006), with no significant difference in the sensory block duration and motor block onset.

Conclusion: Addict patients have delayed onset of sensory block with shorter duration of motor block and lower sensory block level. Among the blood gas and CSF markers, only pH was significantly higher in addict patients, needing further evaluations; however, it seems that addiction has no significant effect on these parameters.

Keywords: Opioid-related disorders; Anesthesia, Spinal; Opium; Bupivacaine; Cerebrospinal fluid

Citation: Derakhshan P, Imani F, Seyed-Siamdoust SA, Garousi S, Nouri N. **Cerebrospinal Fluid and Spinal Anesthesia Parameters in Healthy Individuals versus Opium-addict Patients during Lower Limb Surgery.** Addict Health 2020; 12(1): 11-7.

Received: 23.08.2019 **Accepted:** 27.10.2019

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Introduction

Management of anesthesia in addict patients is challenging for anesthesiologists. Addict patients are prone to hemodynamic instability as well as lower pain threshold, spinal anesthesia duration, and level of sensory block.[1-7]

Chronic opiate use can result in tolerance to analgesics.[6,8] This could be due to the cross-tolerance or cross-interaction among local anesthetics and opioids at the receptor volume of the spinal cord.[6] In addicts, there is a change in the spinal neuronal activity and its associated mediators, neuronal cellular channels, and decreased amount of receptors due to high exposure to opioids.[3,6]

Reports show that opiates could cause mild respiratory acidosis due to the respiratory depression. Plasma acidosis can lead to diffusion of H+ to cerebrospinal fluid (CSF). Acidosis reduces the lipophilicity, hence enhancing efficiency of the local anesthetics.[8]

Besides changes in blood gas of CSF, the CSF profile changes in addict patients compared to non-addicts that can affect the spinal anesthesia outcome; this issue still needs further studies. In this study, the objective is to evaluate the CSF and spinal parameters in healthy versus opium-addict patients during lower limb surgery.

Methods

In this case-control study, 22 addict and 22 non-addicts patients in the age range of 18-79 years old were recruited. The patients were classified in grades II and III based on the American Society of Anesthesiologists (ASA) who were undergoing elective lower limb surgeries with spinal anesthesia at Rasoul-e-Akram Hospital, Tehran, Iran in 2018. The exclusion criteria were neurologic disorders, chronic inflammatory diseases (CIDs) or systemic diseases [hypertension, diabetes mellitus (DM), obesity, and chronic liver or renal diseases], alcohol abuse, psychiatric disorders and hypersensitivity to any medications used, and any contraindications to spinal anesthesia. The study protocol was approved by the ethics committee of Iran University of Medical Sciences with code IR.IUMS.FMD.REC.1397.142. A written informed consent form was received from all patients and they declared their agreement on the blood and CSF sampling during the study.

The patients were kept fasting as eight hours during the night before the surgery. 5 ml/kg of Ringer's lactate solution (RL) was infused as preloading in all patients. In the operation room and recovery part, standard monitoring was performed [including noninvasive blood pressure, electrocardiography (ECG), heart rate, and pulse oximetry measurements] and supplemental oxygen was delivered through a mask (5 l/minute). After proper preparation in the aseptic conditions, spinal anesthesia was performed at the L4-L5 interspace by the midline or paramedian approach by a 25G Quincke spinal needle in the sitting position. The anesthetic medication was injected at a rate of approximately 0.2 ml/s and then, all patients laid down to the supine position.

The analgesia level was checked every 10 seconds until 15 minutes with pinpricks by other anesthesiologists who were blinded about the patients' status. Then, the analgesia level was checked every 5 minutes from minutes 10 to 180 after the spinal injection. If the spinal anesthesia failed, general anesthesia replaced to manage the surgery. The time to achieve T10 sensory block was recorded (using a pinprick test) as the sensory block onset time.

It took 5 minutes to measure the glucose level, total protein, and venous blood gas (VBG) of the blood samples before the injection of the spinal anesthetic. CSF was obtain after the Dural puncture. 2 ml of CSF was collected and subsequently transported under standard conditions to the clinical laboratory; the CSF samples were used to measure glucose, total protein, pH, and partial pressure of carbon dioxide (PCO_2).

All data were analyzed using SPSS software (version 23, IBM Corporation, Armonk, NY, USA) and the results were expressed as mean ± standard deviation (SD) or percentage. The Kolmogorov-Smirnov test was employed to assess the normal data distribution. Additionally, the chi-square test, Fischer's exact test, and independent t-test were utilized to compare data between the groups. P values of less than 0.05 were considered to be statistically significant.

Table 1. Demographic characteristics of the subjects in the two groups

Variable		Addict patients	Non-addict patients	P
Age (years) (mean ± SD)		46.36 ± 11.61	46.09 ± 11.87	0.930
Gender [n (%)]	Male	20 (90.9)	19 (86.4)	-
	Female	2 (9.1)	3 (13.6)	
ASA [n (%)]	II	17 (77.3)	17 (77.3)	-
	III	5 (22.7)	2 (22.7)	

ASA: American Society of Anesthesiologists; SD: Standard deviation

Results

22 addicted and 22 non-addicted patients were evaluated in this study and the two groups were similar in terms of the demographic characteristics (Table 1), with the CONSORT diagram shown in figure 1.

The blood and CSF analysis among the addict and non-addict patients showed similar VBG, blood glucose, and CSF markers between the two groups with no significant difference, except that the addict patients had significantly higher pH in VBG (P = 0.030) and CSF analysis (P = 0.040) (Table 2).

The addict patients had significantly later onset of sensory block and shorter duration of motor block (Table 3). These patients also had shorter duration of sensory block and more duration of motor block, with no significant differences.

Discussion

The findings of the current study showed that addict patients compared to the non-addict ones had significantly later onset of sensory block and shorter duration of motor block; albeit not significant, in addition to later onset of motor block and shorter duration of sensory block.

Different studies have demonstrated similar results;[3,4,7] Mansourian et al.[3] found that among patients undergoing lower limb surgery with spinal anesthesia, opium addicts had shorter duration of anesthesia compared to the non-addicts.

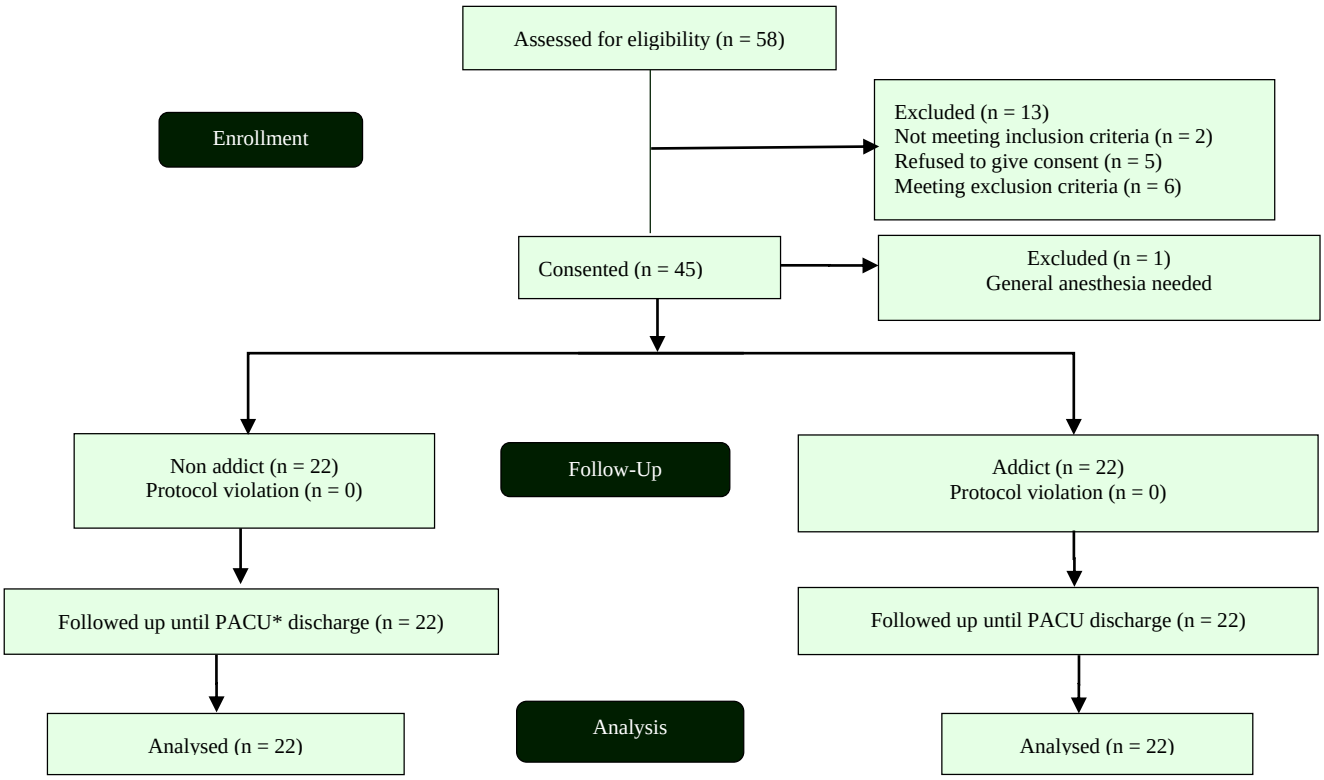

Figure 1. CONSORT diagram
PACU: Postanesthesia care unit

Table 2. Blood and cerebrospinal fluid (CSF) analysis between the two groups

Variable	Addict patients (mean ± SD)	Non-addict patients (mean ± SD)	P
VBG pH	7.39 ± 0.06	7.33 ± 0.11	0.030*
VBG CO_2	44.46 ± 6.05	44.83 ± 6.17	0.800
VBG O_2	48.50 ± 14.69	45.62 ± 12.47	0.970
Blood total protein	6.67 ± 0.30	6.66 ± 0.29	0.910
Blood glucose	93.27 ± 8.07	93.63 ± 7.04	0.870
CSF pH	7.39 ± 0.07	7.35 ± 0.06	0.040*
CSF PCO_2	38.96 ± 7.89	41.45 ± 7.18	0.270
CSF O_2	123.05 ± 31.05	113.46 ± 28.04	0.280
CSF total protein	21.18 ± 1.61	21.05 ± 1.70	0.790
CSF glucose	43.63 ± 4.31	42.31 ± 4.68	0.870

VBG: Venous blood gas; CSF: Cerebrospinal fluid
*P showing two-tailed significance

Due to their tolerance, higher doses of anesthetics were required. Zirak et al.[9] reported similar results and noted that in order to increase the duration of sensory block in addict patients, higher doses or combination of different medications were needed. Karbasy and Derakhshan[6] reported lower level and shorter duration of block in addict patients. Dabbagh et al.[4] observed that addict patients had shorter sensory and motor block duration. Beirami et al.[10] reported a shorter duration of spinal anesthesia by bupivacaine in drug dependent patients in comparison to the non-dependent ones. In another study, Sadeghi et al.[11] reported shorter duration of spinal anesthesia among the addicted patients. They concluded that adding another medication would increase the duration of anesthesia as equivalent to the non-addict patients. Although different types of medications are used for anesthesia, the overall conclusion was the same. Addict and drug-dependent patients have shorter duration of spinal anesthesia and shorter duration of sensory block and to increase the spinal anesthesia duration, higher doses or second medication are needed.

Unlike the present study findings, Majidi et al.[12] reported similar duration of local anesthesia using lidocaine between the addict and non-addict patients with skin lacerations. Of course, the route of administration of the anesthesia medication and the type of intervention, as well as surgery versus stitching would be the causes for these differences.

Previous studies suggested that different receptors in central and peripheral nervous system would be influenced by opioids.[13,14] This downregulation of the receptors and their connected intracellular systems in addicts, resulting in a cross-tolerance to local anesthetics, would occur in spinal anesthesia that could reduce its efficacy and cause shorter duration of anesthesia.[15-18] However, still further studies are needed to define the exact mechanism.

Another mechanism suggested for the reduced efficacy of local anesthetics is the respiratory acidosis caused by the respiratory depression due to opioid use. The H^+ diffused to CSF is followed by these changes.[8] Opium addiction can influence many physiological factors due to the opioid receptor distribution, including nervous and immune systems. Therefore, opioids can alter the immune system response, especially in response to different stresses such as surgery.[19] The acidosis itself can cause toxicity by decreasing plasma protein binding of anesthetics,[12] however in the present study, it was shown that this theory was not true. Considering the afore-mentioned mechanisms, it was assumed in this study that opium addict patients would have changes in the blood gas and CSF markers compared to the non-addicts, but it was observed that these patients had significantly higher pH in VBG and CSF analyses, which needs further evaluation.

Table 3. Sensory and motor block parameters between the two groups

	Addict patients	Non-addict patients	P value
Sensory blockage onset	5.72 ± 1.57	3.16 ± 0.93	< 0.001*
Sensory blockage duration	110.90 ± 17.08	115.90 ± 16.94	0.330
Motor blockage onset	8.81 ± 2.36	7.59 ± 2.21	0.080
Motor blockage duration	137.72 ± 11.51	149.09 ± 14.44	0.006*

*P showing two-tailed significance

This study faced some limitations, including small sample size. The duration of opium use was likely to affect the analgesic response during the spinal anesthesia. However, the history of opium use and its correlation with the spinal anesthesia duration were not considered in this study. In addition, the exact dose of opium use and its correlation were not measured.

Conclusion

In conclusion, addict patients have delayed onset of sensory block with shorter duration of motor block and lower motor block level. Among the blood gas and CSF markers, only pH was significantly higher in addict patients; however, it seems that addiction has no significant effect on these parameters. Further studies are necessary to evaluate these findings.

Conflict of Interests

The Authors have no conflict of interest.

Acknowledgements

The authors would like to appreciate all anesthesiologists and personnel of Rasoul-e-Akram of Tehran.

Authors' Contribution

PD and SASS, participated in the study concept and design. SG and NN, performed analysis and interpretation of data. PD and FI, drafting of the manuscript conducted. PD and SG, preformed the revision of the manuscript for important intellectual content, and statistical analysis.

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DOI: *http://dx.doi.org/10.22122/ahj.v12i1.257* *Published by Vesnu Publication*

تفاوت‌های بین مشخصه‌های مایع مغزی نخاعی و بی‌حسی نخاعی در بیماران سالم و معتاد در اعمال جراحی اندام تحتانی

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مقاله پژوهشی

چکیده

مقدمه: مطالعات نشان دهنده آستانه درد پایین‌تر، طول مدت کمتر بی‌حسی نخاعی و سطح حسی پایین‌تر در بیماران معتاد نسبت به بیماران سالم در جراحی به روش بی‌حسی نخاعی است. امکان دارد این مسأله در مورد مایع مغزی نخاعی و گازهای خونی شریانی نیز مشاهده شود. هدف از انجام پژوهش حاضر، بررسی تفاوت بین مشخصه‌های مایع مغزی نخاعی و بی‌حسی نخاعی در بیماران معتاد و سالم بود.

روش‌ها: در این مطالعه مورد- شاهدی، ۲۲ بیمار معتاد و ۲۲ بیمار سالم که از نظر جنس و سن یکسان بودند، شرکت داشتند. مشخصه‌های مایع مغزی نخاعی، گازهای خون شریانی و یافته‌های بلوک حسی و حرکتی بین دو گروه مقایسه گردید.

یافته‌ها: تفاوت معنی‌داری در مشخصه‌های مایع مغزی نخاعی و گازهای خونی شریانی بین دو گروه معتاد و سالم وجود نداشت؛ به جزء pH در گازهای خون شریانی (۰/۰۶ ± ۷/۳۹ در مقابل ۰/۱۱ ± ۷/۳۳، P = ۰/۰۳۰) و مایع مغزی نخاعی (۰/۰۶ ± ۷/۳۹ در مقابل ۰/۱۱ ± ۷/۳۳، P = ۰/۰۳۰) که در بیماران معتاد بالاتر بود. معتادان به طور مشخص دارای سرعت ایجاد بلوک حسی طولانی‌تر (۱/۵۷ ± ۵/۷۲ در مقابل ۰/۹۳ ± ۳/۱۶ دقیقه، P < ۰/۰۰۱) و طول مدت بلوک حرکتی کوتاه‌تری (۱۱/۵۱ ± ۱۳۷/۷۲ در مقابل ۱۴/۴۴ ± ۱۴۹/۰۹ دقیقه، p = ۰/۰۰۶) بودند که با طول بلوک حسی و سرعت ایجاد بلوک حرکتی متفاوتی همراه نبود.

نتیجه‌گیری: در افراد معتاد، سرعت ایجاد بلوک حسی دیرتر، طول مدت بلوک حرکتی کمتر و سطح بلوک حسی پایین‌تر است. همچنین، بین مایع مغزی نخاع و گازهای خون شریانی دو گروه، فقط pH در بیماران معتاد بیشتر می‌باشد که به بررسی‌های بیشتری در آینده نیاز دارد. به هر حال، به نظر نمی‌رسد که اعتیاد بر روی مشخصه‌های مایع مغزی نخاعی و بی‌حسی نخاعی تأثیر مشخصی داشته باشد.

واژگان کلیدی: اختلالات مربوط به به مواد مخدر، بی‌حسی، نخاعی، مخدر، بوپیواکائین، مایع مغزی نخاعی

ارجاع: درخشان پویا، ایمانی فرناد، سید صیام‌دوست سید علیرضا، گروسی سرور، نوری نسرین. **تفاوت‌های بین مشخصه‌های مایع مغزی نخاعی و بی‌حسی نخاعی در بیماران سالم و معتاد در اعمال جراحی اندام تحتانی.** مجله اعتیاد و سلامت ۱۳۹۸؛ ۱۲ (۱): ۱۷-۱۱.

تاریخ دریافت: ۱۳۹۸/۶/۱ **تاریخ پذیرش:** ۱۳۹۸/۸/۵

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