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SCIENTIFIC ARTICLE

# Monitorization of the effects of spinal anaesthesia on cerebral oxygen saturation in elder patients using near-infrared spectroscopy

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**KEYWORDS**
Cerebral oxygen saturation;
Spinal anaesthesia;
Near-infrared spectroscopy

**Abstract**
*Objective:* Central blockage provided by spinal anaesthesia enables realization of many surgical procedures, whereas hemodynamic and respiratory changes influence systemic oxygen delivery leading to the potential development of series of problems such as cerebral ischemia, myocardial infarction and acute renal failure. This study was intended to detect potentially adverse effects of hemodynamic and respiratory changes on systemic oxygen delivery using cerebral oxymetric methods in patients who underwent spinal anaesthesia.
*Methods:* Twenty-five ASA I–II Group patients aged 65–80 years scheduled for unilateral inguinal hernia repair under spinal anaesthesia were included in the study. Following standard monitorization baseline cerebral oxygen levels were measured using cerebral oximetric methods. Standardized Mini Mental Test (SMMT) was applied before and after the operation so as to determine the level of cognitive functioning of the cases. Using a standard technique and equal amounts of a local anaesthetic drug (15 mg bupivacaine 5%) intratechal blockade was performed. Mean blood pressure (MBP), maximum heart rate (MHR), peripheral oxygen saturation ($SpO_2$) and cerebral oxygen levels ($rSO_2$) were preoperatively monitored for 60 min. Pre- and postoperative haemoglobin levels were measured. The variations in data obtained and their correlations with the cerebral oxygen levels were investigated.
*Results:* Significant changes in pre- and postoperative measurements of haemoglobin levels and SMMT scores and intraoperative $SpO_2$ levels were not observed. However, significant variations were observed in intraoperative MBP, MHR and $rSO_2$ levels. Besides, a correlation between variations in $rSO_2$, MBP and MHR was determined.

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*Conclusion:* Evaluation of the data obtained in the study demonstrated that post-spinal decline in blood pressure and also heart rate decreases systemic oxygen delivery and adversely effects cerebral oxygen levels. However, this downward change did not result in deterioration of cognitive functioning.


**PALAVRAS-CHAVE**
Saturação de oxigênio cerebral;
Raquianestesia;
Espectroscopia de luz próxima ao infravermelho (NIRS)

**Monitoramento dos efeitos da raquianestesia sobre a saturação de oxigênio cerebral em pacientes idosos com o uso de espectroscopia de luz próxima ao infravermelho**

**Resumo**
*Justificativa e Objetivo:* o bloqueio central proporcionado pela raquianestesia possibilita a realização de muitos procedimentos cirúrgicos, enquanto as alterações hemodinâmicas e respiratórias influenciam a oferta de oxigênio sistêmico, levando ao desenvolvimento em potencial de uma série de problemas, como isquemia cerebral, infarto do miocárdio e insuficiência renal aguda. O objetivo deste estudo foi detectar potenciais efeitos adversos das alterações hemodinâmicas e respiratórias sobre a oferta de oxigênio sistêmico, usando métodos oximétricos cerebrais em pacientes submetidos à raquianestesia.
*Métodos:* vinte e cinco pacientes, 65–80 anos de idade, estado físico ASA I–II, programados para correção de hérnia inguinal unilateral sob raquianestesia foram incluídos no estudo. De acordo com o monitoramento padrão, os níveis de oxigênio cerebral foram medidos no início do estudo usando métodos oximétricos cerebrais. O Mini Teste Padronizado do Estado Mental (Standardized Mini Mental Test – SMMT) foi aplicado antes e depois da operação para determinar o nível de funcionamento cognitivo dos casos. Usando uma técnica padrão e quantidades iguais de um fármaco anestésico local (15 mg de bupivacaína a 5%), o bloqueio intratecal foi realizado. Pressão arterial média (PAM), frequência cardíaca máxima (FCM), saturação periférica de oxigênio ($SpO_2$) e níveis cerebrais de oxigênio ($rSO_2$) foram monitorados no pré-operatório por 60 min. Os níveis pré- e pós-operatórios de hemoglobina foram medidos. As variações nos dados obtidos e suas correlações com os níveis cerebrais de oxigênio foram investigadas.
*Resultados:* não observamos alterações significativas nas mensurações de hemoglobina, escores do SMMT e níveis de $SpO_2$ nos períodos pré- e pós-operatório. No entanto, variações significativas foram observadas nos níveis de PAM, FCM e $rSO_2$ no período intraoperatório. Além disso, a correlação entre as variações de $rSO_2$, PAM e FCM foi determinada.
*Conclusão:* a avaliação dos dados obtidos no estudo demonstrou que a queda da pressão arterial pós-raquianestesia e também da frequência cardíaca diminui a oferta de oxigênio sistêmico e afeta negativamente os níveis cerebrais de oxigênio. Contudo, essa alteração não resultou em deterioração da função cognitiva.


## Introduction

Though main objective of spinal anaesthesia is to provide sensory and motor blockade, sympathetic denervation is regarded as a side effect inducing the development of systemic alterations.[1] Spinal anaesthesia-related hypotension is the most frequently encountered complication. Systemic vascular resistance decrease, as a result of decreased arterial pressure and heart rate decrease secondary to sympathetic blockade resulting in decline in cardiac output. Systemic delivery of oxygen decreases in proportion with a decrease in cardiac output leading to an onset of many problems such as development of cerebral ischemia, myocardial infarction, acute renal failure and cardiac arrest because of tissue hypoxia.[1,2]

Elder population increases globally at an extremely higher rate in parallel with improvements in the quality of life. Elder and very old people are considered to be $\geq$65 and $\geq$80 years of age, respectively.[3] When compared with general anaesthesia, application of spinal anaesthesia offers elder people some advantages during and after the operation as preservation of cognitive functioning, lesser amount of intraoperative bleeding, decreased risk of thromboembolism and provision of effective analgesia. However, it has also some disadvantages as hypotension, bradycardia and delayed ambulation.[4–10]

Even if decreased cardiac output caused by spinal anaesthesia does not impair hemodynamic processes and systemic delivery of oxygen at an extreme rate or induce clinical symptoms, it especially exerts a certain impact on cerebral blood flow. Even though markedly depressing effects of hypotension on cerebral circulation of particularly elder patients has been noted in various studies, this subject is still debatable.[11,12]

The main objectives of neuromonitorization are to maintain and preserve neurological functions and provide optimal conditions for their improvement. To that end non-invasive near-infrared spectroscopy (NIRS)-based cerebral oximeter