



Quick Evaluation of Cerebral Autoregulation Limits with Near Infrared Spectroscopic Techniques in the Intraoperative Period

Intraoperatif Dönemde Near-İnfrared Spektroskopi Teknikleri ile Serebral Otoregülasyon Limitlerinin Hızlı Değerlendirilmesi

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In this manuscript, we describe a significant advantage of the intraoperative near infrared spectroscopic techniques (NIRS) using in a malignant hypertensive patient during kidney transplantation. This patient underwent operation because of the presence of a suitable cadaveric kidney. Moreover, although the patient's hypertension was intensively treated by cardiology for a long time, it could not be controlled. Thus, despite severe hypertension, the patient was anaesthetized. Mean arterial pressures of about 70-90 mmHg, which are considered to be normal for most people, could cause cerebral hypoperfusion in such a patient. It is a significant advantage that the lower limit of cerebral autoregulation is quickly assessed by NIRS in the case of a kidney transplant performed under general anaesthesia.

Keywords: Cerebral autoregulation, near infrared spectroscopy, kidney transplantation, hypertension, anaesthesia, monitoring

Bu yazıda, böbrek transplantasyonu sırasında malign hipertansiyonu olan bir hastada intraoperatif Near-İnfrared Spektroskopi (NIRS) kullanımının önemli bir avantajından söz etmek istedik. Bu hasta uygun bir kadavradan böbrek varlığı nedeniyle ameliyata alınmak zorunda kalmıştır. Ayrıca, hastanın hipertansiyonu kardiyoloji tarafından uzun süredir tedavi edilmesine rağmen kontrol altına alınamamıştır. Bu nedenlerle, malign hipertansiyonuna rağmen, hastaya anestezi verilmiştir. Çoğu insan için normal kabul edilen 70-90 mmHg ortalama arter basıncı, böyle bir hastada serebral hipoperfüzyona neden olabilir. Genel anestezi altında yapılan bir böbrek transplantasyonunda, serebral otopregülasyonun alt limitinin NIRS tarafından hızla değerlendirilmesi büyük bir avantajdır.

Anahtar Kelimeler: Serebral otopregülasyon, near infrared spektroskopisi, böbrek transplantasyonu, hipertansiyon, anestezi, monitörizasyon

Introduction

Cerebral autoregulation is an important mechanism that maintains stable cerebral blood supply, despite changes in mean arterial blood pressure (MAP). The autoregulation mechanism is effective between 50-150 mmHg MAP values. Within this range, vasomotor tonus offers cerebrovascular resistance, therefore cerebral blood flow remains relatively constant (1). In chronic hypertension, static autoregulatory curve shifts rightward and cerebral blood flow decreases because of long term structural changes in small vessels. Transcranial doppler ultrasound and near infrared spectroscopic techniques (NIRS) are used for evaluating cerebral blood flow and oxygenation. It is also believed that NIRS monitoring relays information about cerebral autoregulation (2). In this manuscript, we would like to mention a significant advantage of the intraoperative NIRS using in a malignant hypertensive patient during kidney transplantation.

Case Presentation

A 31-year-old male patient was scheduled for kidney transplantation. He had chronic renal failure for 10 years, uncontrolled hypertension for 20 years, diabetes mellitus, and eye surgery. Baseline monitoring was established. NIRS (INVOS 5100, Somanetics Corporation, Troy, MI, USA) optodes were placed bilateral forehead. Baseline systolic, diastolic and mean arterial blood pressures were 220/120 (153) mmHg, left and right rSO₂ levels were 60/62, bispektral index (BIS™, Covidien, MN, USA) was 96. After general anaesthesia was administered, arterial blood pressure decreased to 135/75 (95) mmHg, rSO₂ were 54/56, BIS was 47. Anaesthesia was maintained with remifentanyl/desflurane/air/oxygen. Thirty minutes after the start of surgery while maintaining a good surgical outlook, arterial blood pressure dropped to 110/60 (77) mmHg, which

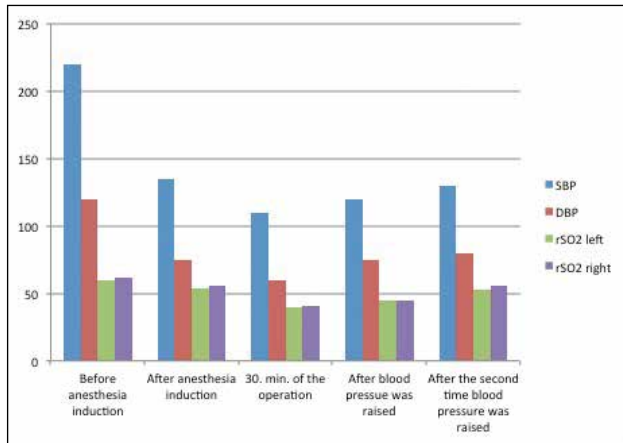


Figure 1. Changes in systolic blood pressure, diastolic blood pressure, and cerebral oxygenation over time

was a normal blood pressure value for most people. NIRS rSO_2 decreased 40/41 fell by 33% and 35% compared to the initial values and BIS 37 at the same time (Figure 1). No changes were noted in other parameters such as hemoglobin, oxygen, carbondioxide, central venous pressure, pleth variability index, and pulse pressure variation during this period. This patient had hypertension that could not be controlled because of renal disease, so adequate cerebral perfusion was achieved with higher arterial blood pressures; the cerebral autoregulation curve was considered to have shifted to the right. Thereupon, blood pressure increased, the arterial blood pressure was 120/75(90), the NIRS values were 45/45 (25%, 28%). Because the rSO_2 values were still 25% lower than the initial rSO_2 value, the blood pressure increased to 130/80(97) mmHg and rSO_2 was noted to be 53/56. We interpreted this as the lower limit of the patient's cerebral autoregulation curve as 130/80 (97) mmHg blood pressure values, and kept the blood pressure above the specified value throughout the operation. There was no intraoperative or postoperative complication, he was extubated in the OR and was transferred to the intensive care unit in a state of consciousness. The patient was informed for the presentation.

Discussion

In this report, we aimed to present an interesting case, about the usefulness of quick and noninvasive assessing the cerebral autoregulation limits with NIRS monitoring. This patient underwent a kidney transplant because of the presence of a suitable cadaveric kidney. Moreover, although the patient's hypertension was intensively treated by cardiology for a long time, it couldn't be controlled. Therefore, despite severe hypertension, the patient was anesthetised. Mean arterial pressures of about 70-90 mmHg, which are considered normal for most people, could cause cerebral hypoperfusion in such a patient. Hypoperfusion is one of the most important causes of postoperative poor neurological outcomes (1). There are clinical situations, such as paediatric surgery, carotid surgery, cardiopulmonary bypass where monitoring cerebral perfusion and

autoregulation could help prevent brain damage and guide the adjustments to the procedure (1, 3). Near infrared-based devices have been shown to be effective for the non-invasive evaluation of cerebral autoregulation limits, where the use of transcranial doppler ultrasonography is limited (4). In a study of cerebral autoregulation patterns assessed using NIRS during cardiopulmonary bypass, targeting individualised arterial blood pressures on the basis of cerebral autoregulation monitoring was reported to be more effective than standard methods for the prevention of cerebral hypoperfusion and hyperperfusion (5).

Conclusion

It is a great advantage that the lower limit of cerebral autoregulation is quickly assessed by NIRS in such a hypertensive case of a kidney transplant performed under general anaesthesia.

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References

1. Kainerstorfer JM, Sassaroli A, Tgavalekos KT, Fantini S. Cerebral autoregulation in the microvasculature measured with near-infrared spectroscopy. *J Cereb Blood Flow Metab* 2015; 35: 959-66. [CrossRef]

2. Moerman A, De Hert S. Recent advances in cerebral oximetry. Assessment of cerebral autoregulation with near-infrared spectroscopy: myth or reality? *F1000 Res* 2017; 6: 1615. [\[CrossRef\]](#)
3. Wagner BP, Ammann RA, Bachmann DC, Born S, Schibler A. Rapid assessment of cerebral autoregulation by near-infrared spectroscopy and a single dose of phenylephrine. *Pediatr Res* 2011; 69: 436-41. [\[CrossRef\]](#)
4. Murkin JM, Kamar M, Silman Z, Balberg M, Adams SJ. Intraoperative Cerebral Autoregulation Assessment Using Ultrasound-Tagged Near-Infrared-Based Cerebral Blood Flow in Comparison to Transcranial Doppler Cerebral Flow Velocity: A Pilot Study. *J Cardiothorac Vasc Anesth* 2015; 29: 1187-93. [\[CrossRef\]](#)
5. Moerman AT, Vanbiervliet VM, Van Wesemael A, Bouchez SM, Wouters PF, De Hert SG. Assessment of Cerebral Autoregulation Patterns with Near-infrared Spectroscopy during Pharmacological-induced Pressure Changes. *Anesthesiology* 2015; 123: 327-35. [\[CrossRef\]](#)