

Continuous Monitoring of Cerebral Near-Infrared Spectroscope (NIRS) after Cerebral Air Embolism

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Abstract

An elderly woman suddenly had a right side cerebral air embolism (CAE) with seizures and unconsciousness during bronchoscopic biopsies, so was transferred to our hospital. Magnetic resonance imaging (MRI) showed no acute ischemic changes two hours after CAE in both hemispheres. Despite no active MRI findings, near-infrared spectroscope (NIRS), started soon after the MRI, showed lower regional oxygen saturations (rSO₂) in the right side as compared to the unaffected side. These changes lasted for about two days, which suggested cerebral blood flow alterations in the CAE side. Three days later, she regained consciousness but had paresis of the left upper limb. Thus, we might need to pay attention to changes in rSO₂ using continuous monitoring of NIRS after CAE.

Keywords: Cerebral air embolism (CAE); Cerebral infarction; Magnetic resonance image (MRI); Near-Infrared spectroscopy (NIRS).

Introduction

Cerebral air embolism (CAE) during bronchoscopic lung biopsy becomes fatal in less than 0.02% of cases [1]. So, there have been limited reports regarding detailed time course changes in the neuroimagings. Near-infrared spectroscope (NIRS) has been widely used for detecting changes in cerebral oxygen metabolism during cardiac surgery and neurosurgery [2]. We report here for the first time that continuous monitoring of NIRS could provide earlier information of cerebral oxygen changes soon after CAE as compared to the neuroimagings. We have an informed consent for publication obtained from the current case.

Case Report

An 82-year-old woman suddenly presented with seizures and loss of consciousness after starting biopsies for a lung tumor using a bronchoscope at a regional hospital. The first cerebral computed tomography (CT) revealed massive cerebral air embolism (CAE) mainly in the right hemisphere (Figure 1A, a, arrows show air densities; a left frontal defect was due to old cerebral trauma). She was transferred to our hospital for intensive care. The second cerebral CT performed two hours after the episode did not show any air densities, nor brain magnetic resonance imaging (MRI) revealed acute ischemic changes (Figure 1A, b and c), so hyperbaric oxygen therapy (HBO) was not performed. On day 2, after discontinuing sedation, partial seizures of her left upper limb were noted. The third CT after partial seizures showed no active findings (Figure 1A,d). On day 3 she regained consciousness and was extubated. But, she had a left upper limb paresis. The second MRI taken on day 9 showed diffusionweighted high intensity in the right frontal and parietal cortices (Figure 1A,e).

In this case, cerebral tissue oxygenation was monitored with a NIRS (INVOS 5100C, Covidien, Boulder, CO, USA) after the initial MRI on

day 1. As shown in the Figure 1B, there were clear differences in regional oxygen saturation (rSO_2) between the right and left measured sites, which were followed by their disappearance 53 hours after monitoring.

Discussion

CAE during bronchoscopic biopsy becomes fatal in less than 0.02 % of cases [1]. Gas is thought to enter through the broncho-pulmonary venous fistula after biopsy into the pulmonary vessel system, causing air embolization [1]. In this case, we did not apply HBO since there were no active findings either in the CT or MRI taken two hours after the episode. Only one review suggests a beneficial effect of HBO for CAE. But, it is uncertain whether full recovery could be obtained in this case even if HBO was done.

NIRS reflects changes in tissue blood flow and the balance between oxygen supply and demand, so is used for detecting changes in cerebral tissue blood flow during cardiac surgery or neurosurgery [2,3]. In an animal model, rSO₂ detects the effects of CAE on cerebral tissue oxygenation [4]. In the current case, NIRS showed significant decreases in affected-side rSO₂, despite no acute ischemic findings in the initial CT or even MRI. Thus, this difference might suggest that NIRS could detect the changes in cerebral tissue blood flow resulting from CAE more sensitively than MRI in the acute phase. An animal ischemic/reperfusion model showed that, after reperfusion, the cerebral oxygen consumption was returned to the pre-ischemic levels, but oxygen extraction remained elevated, thereby leading to oxygen demand/supply mismatch [5]. So the current results of NIRS might also reflect cerebral oxygen demand/supply mismatch after reperfusion from CAE. To the best of our knowledge, this is the first case report suggesting that continuous rSO₂ monitoring could detect cerebral tissue oxygen impairments in acute CAE earlier than MRI. Thus, we might need to pay attention to changes in rSO₂ using continuous monitoring of NIRS after CAE.

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48hrs

24hrs

Figure 1: A) Shows serial CTs and MRIs after cerebral air embolism caused by bronchoscopic biopsies, B) Depicts time course changes in NIRS in the right and left sides after the first MRI taken two hours after CAE. As shown in the Figure, there are definitive differences in rSO_2 between the two sides for approximately fifty-three hours, which are followed by a disappearance of their discrepancy.

70

60

100

50

72hrs

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