Case Report

Brainstem anesthesia during removal operation of ventriculoperitoneal shunt – A case report

Satoshi Miyamoto¹, Go Ikeda¹, Ken Akimoto¹, Ryota Mashiko¹, Kazuya Uemura¹, Eiichi Ishikawa²

¹Department of Neurosurgery, Tsukuba Medical Center Hospital, ²Department of Neurosurgery, University of Tsukuba, Tsukuba, Ibaraki, Japan.

E-mail: Satoshi Miyamoto - satomiya00@gmail.com; Go Ikeda - ikeda.go@tmch.or.jp; Ken Akimoto - akimoto-aic@umin.ac.jp; Ryota Mashiko - ryotamashiko@ybb.ne.jp; Kazuya Uemura - kazuyase@mac.com; Eiichi Ishikawa - e-ishikawa@md.tsukuba.ac.jp

*Corresponding author:
Eiichi Ishikawa,
Department of Neurosurgery,
University of Tsukuba, Tsukuba,
Ibaraki, Japan.
e-ishikawa@md.tsukuba.ac.jp

ABSTRACT

Background: Brainstem anesthesia is a transient loss of brainstem function usually associated with retrobulbar block and rarely seen by neurosurgeons.

Case Description: Here, we report a case of brainstem anesthesia during shunt revision operation in a 79-year-old woman. Local anesthesia administered at the end of surgery was thought to have infiltrated the subarachnoid space through a burr hole, causing prolonged unconsciousness and cranial nerves' impairment. Spontaneous resolution occurred during systemic support.

Conclusion: As brainstem anesthesia may occur by leakage of local anesthetic through small burr holes, timing injections carefully can avoid this rare complication.

Keywords: Brainstem anesthesia, Burr hole surgery, Local anesthetics, Neurosurgery

INTRODUCTION

Brainstem anesthesia is a transient loss of brainstem function due to anesthetic drug infiltration, which is famous as a complication of retrobulbar block for ocular surgery. On the other hand, this complication is very rare in neurosurgery and no case has been reported especially in a burr hole surgery. Here, we report a case of brainstem anesthesia during operation of ventriculoperitoneal shunt tube removal.

CASE REPORT

A 79-year-old female experiencing gait disturbance, cognitive impairment, and urinary incontinence for about a year presented at our hospital. CT head scanning showed enlarged ventricles (Evan's index 0.31) and no other remarkable signs [Figure 1]. A lumbar tap test showed slight improvement of gait and memory function. After a diagnosis of probable normal-pressure hydrocephalus, a ventriculoperitoneal shunt operation was completed without complications. However, symptoms did not greatly improve and the patient demanded a shunt removal. Before removal, gait instability and mild cognitive impairment were present without any paralysis, sensory dysfunction, or cranial nerve palsy.
A previous report proposed that no definitive diagnostic criteria exist for brainstem anesthesia due to spreading through the optic nerve sheath into the subarachnoid space. However, systemic management in an intensive care unit was conducted and, within an hour, pupil size, dysarthria, loss of pupillary light reflex, and/or dilated pupils, were not observed. In addition, intoxication by local anesthetic drugs, such as bupivacaine, equally neurotoxic, has been implicated in multiple reports of this phenomenon but has also been reported as a cause of brain anesthesia.

Symptoms, diagnosis, and treatment
Symptoms of brainstem anesthesia are loss of consciousness, apnea, and cranial nerve paralyses, resulting in dysphagia, dysarthria, loss of pupillary light reflex, and/or dilated pupils. Since no definitive diagnostic procedures currently exist for this disease, differential diagnoses such as anaphylactic shock, brainstem infarction, local anesthetic intoxication, brainstem hemorrhaging, seizure, or hypothermia should be excluded before diagnosing this condition. Its spontaneous recovery course is also helpful for diagnosis. A previous report proposed auditory brainstem response as a useful way to distinguish brainstem anesthesia from high spinal anesthesia but further research is required for confirmation. The primary treatment for brainstem anesthesia is, therefore, systemic, that is, respiratory management and blood pressure control. Full recovery of symptoms can be achieved in 30 min to several hours but the condition can be fatal if left untreated.

Present case
In this case, brainstem anesthesia was first noticed through prolonged unconsciousness and dilated bilateral pupils after general anesthesia. We first suspected hemorrhagic or ischemic complications but no abnormal signs were found on postoperative CT and local anesthetic intoxication was excluded because hemodynamic changes due to epinephrine were not observed. In addition, intoxication by local anesthetics often causes cardiotoxicity, such as arrhythmia, which was not seen in this case while no signs of epileptic seizure, hypothermia, or anaphylaxis were present. Acute symptomatic seizure or nonconvulsive status epilepticus due to infiltration of local anesthetics into the cerebrum should also be considered. However, loss of brainstem reflexes such as the vestibular oculomotor reflex and visualization does not occur in this situation. In addition, propofol, which is used for general anesthesia, raises the threshold for seizures, making this diagnosis less likely. Considering the course of spontaneous recovery from brainstem dysfunction, brainstem anesthesia was diagnosed in this case, likely caused by lidocaine or bupivacaine injection at the end of surgery spreading into the subarachnoid space through the burr hole.
Comparison with the previous case

Brainstem anesthesia after neurosurgery is very rare and only four cases have been reported in PubMed (search terms: brainstem and anesthesia [Table 1]).[3,5,12] One was duraplasty case for cerebrospinal fluid leak after occipital decompressive craniotomies while the other three were occipital decompressive craniotomy cases. In all previous cases, local anesthetic leakage through a dura mater opening was suspected as causative but our case is the first related to a burr hole. Brainstem anesthesia is rarely encountered in burr hole surgeries due to rare use of local anesthetics before skin closure, small amounts of local anesthetics for a small incision, and a limited pathway to the subarachnoid space through burr hole surgery versus open brain surgery.

In 80% of brainstem anesthesia cases, local anesthesia was conducted at the end of the operation. Thus, the timing of injection can increase the risk of brainstem anesthesia from possible openings in the dura mater that allows infiltration of local anesthetics. As seen in our case, the cranial tube tract, leading to the subarachnoid space from the burr hole, was open for lidocaine or bupivacaine. If we had instead injected lidocaine or bupivacaine at the beginning of the surgery, we might have avoided this phenomenon since the tract would have been packed with the tube and connective tissue. As such, the timing of local anesthesia should be carefully decided to prevent risks of brainstem anesthesia.

Compared to ophthalmic surgery

Compared to retrobulbar block during ophthalmic surgery,[6,7,10] the general anesthesia mostly used in neurosurgery can mask most brainstem anesthesia symptoms, such as loss of consciousness or apnea. The first clues to indicate this phenomenon in general anesthesia patients, as seen in our case, are prolonged impairment of awareness or dilated pupils.

Since local anesthesia during surgery is becoming more common (with multiple reports of its usefulness for postoperative pain control), especially for gastrointestinal surgery,[9] understanding brainstem anesthesia as a differential diagnostic possibility will prepare the surgical team for the systemic measures necessary to treat it should it arise.

CONCLUSION

We experienced a case of brainstem anesthesia through local anesthetic in a shunt tube removal operation. As brainstem anesthesia may happen even through a burr hole,
neurosurgeons should be vigilant against it by considering possible pathways for local anesthetics into the subarachnoid space and carefully timing administration of local anesthetics.

Acknowledgements
The authors would like to thank Dr. Alexander Zaboronok of the University of Tsukuba, Faculty of Medicine, Department of Neurosurgery for professional and language revision and Dr. Bryan J. Mathis of the University of Tsukuba Hospital International Medical Center for language revision.

Declaration of patient consent
Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES
1. Ashaye AO, Ubah JN, Sotumbi PT. Respiratory arrest after retrobulbar anaesthesia. West Afr J Med 2002;21:343-4.
2. Chin YC, Kumar CM. Brainstem anaesthesia revisited: Mechanism, presentation and management. Trends Anaesth Crit Care 2013;3:252-6.
3. Joannides AJ, Santarius T, Fernandes HM, Laing RJ, Trivedi RA. Transient perioperative brainstem paralysis secondary to a local anesthetic. J Neurosurg Pediatr 2012;10:60-1.
4. Malet A, Faure MO, Deletage N, Pereira B, Haas J, Lambert G. The comparative cytotoxic effects of different local anesthetics on a human neuroblastoma cell line. Anesth Analg 2015;120:589-96.
5. Munis JR, Marcuikaitis AW, Sprung J. Delayed emergence from anesthesia associated with absent brainstem reflexes following suboccipital craniotomy. Neurocrit Care 2006;5:206-9.
6. Nakamura R, Nameki K, Konishi J, Terakado H, Maeda T, Suzuki T. A case with loss of consciousness and respiratory arrest following retrobulbar anesthesia. J Jpn Soc Clin Anesth 2015;35:430-3.
7. Nicoll JM, Acharya PA, Ahlen K, Baguneid S, Edge KR. Central nervous system complications after 6000 retrobulbar blocks. Anesth Analg 1987;66:1298-302.
8. Quantock CL, Goswami T. Death potentially secondary to sub-Tenon's block. Anaesthesia 2007;62:175-7.
9. Roberge CW, McEwen M. The effects of local anesthetics on postoperative pain. AORN J 1998;68:1003-12.
10. Tolesa K, Gebreal GW. Brainstem anesthesia after retrobulbar block: A case report and review of literature. Ethiop J Health Sci 2016;26:589-94.
11. Verlinde M, Hollmann MW, Stevens MF, Hermanns H, Werdehausen R, Lirk P. Local anesthetic-induced neurotoxicity. Int J Mol Sci 2016;17:339.
12. Waters B, Kroll RR, Muscedere J, Lomax LB, Burjorjee JE. Stepwise rostrocaudal brainstem anesthesia as a complication of local anesthesia: A case report. A A Case Rep 2017;9:277-9.
13. Yamashiro H. Differentiation of brain stem anesthesia from high spinal anesthesia using auditory brain stem response. Masui 1990;39:1704-7

How to cite this article: Miyamoto S, Ikeda G, Akimoto K, Mashiko R, Uemura K, Ishikawa E. Brainstem anesthesia during removal operation of ventriculoperitoneal shunt – A case report. Surg Neurol Int 2022;13:122.