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Case Report

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

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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,[2] which is famous as a complication of retrobulbar block for ocular surgery.[2,10] 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.

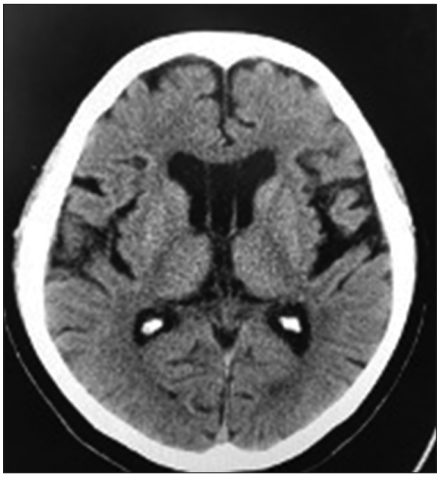

Figure 1: Head CT at admission. Slightly enlarged ventricles with cavum Vergae are visible.

During the operation, propofol (60 mg), rocuronium (35 mg), and remifentanil (0.7 mg/h) were used as general anesthesia with 5% desflurane and remifentanil (0.6 mg/h) continuously infused for maintenance. We injected 10 ml of 0.5% lidocaine with epinephrine into the chest skin incision site and cut the skin to expose the shunt valve; cranial and rostral shunt tubes were removed without resistance. A clip anchor was left at the scalp so we injected 7 ml of 0.5% lidocaine with epinephrine into the previous skin incision site around the burr hole and removed it. The skin was closed after 10 ml of 0.75% bupivacaine was added into the subcutaneous layer to reduce postoperative pain. The total operation and anesthetic times were 22 and 58 min, respectively.

Anesthesia was reversed by Sugammadex and train of four stimulation showed diminishment of muscle relaxants, but spontaneous respiration was still not observed. At this time, vital signs were blood pressure 90/50 mmHg, pulse 80 bpm, SpO2 98%, and body temperature 35.8°C with a Japan Coma Scale score of 300 even after naloxone administration. Pupils were dilated bilaterally and light, cough, and vestibulo-ocular reflexes were lost. Emergent head CT showed no abnormal lesions such as hemorrhages, infarctions, or cerebral herniations [Figure 2]. Under suspicion of brainstem anesthesia, systemic management in an intensive care unit was conducted and, within an hour, pupil size, respiration, and consciousness gradually recovered to normal and extubation occurred 1.5 h after the operation. The postoperative course was uncomplicated and discharge occurred at postoperative day 9.

DISCUSSION

Brainstem anesthesia

Brainstem anesthesia is a transient loss of brainstem function due to anesthetic drugs,[2] occurring when local anesthetics (like lidocaine) infiltrate the brainstem through the subarachnoid space.[2] This phenomenon has been reported as a complication of retrobulbar block for ocular surgery[1,2,6,10] due to spreading through the optic nerve sheath into the subarachnoid space.[2,6] Lidocaine, well known for strong neurotoxicity,[11] has been implicated in multiple reports of this phenomenon[1,6,10] but bupivacaine, equally neurotoxic,[4] has also been reported as a cause of brain anesthesia.[5]

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,[2,6,10] but some reports describe hemodynamic changes such as hypo/hypertension.[2,7] 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.[2,5,6] Its spontaneous recovery course is also helpful for diagnosis.[2,6,10] A previous report proposed auditory brainstem response as a useful way to distinguish brainstem anesthesia from high spinal anesthesia[13] but further research is required for confirmation. The primary treatment for brainstem anesthesia is, therefore, systemic, that is, respiratory management and blood pressure control.[2,6] Full recovery of symptoms can be achieved in 30 min to several hours[3,6,10] but the condition can be fatal if left untreated.[1,8]

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,[7,12] 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.

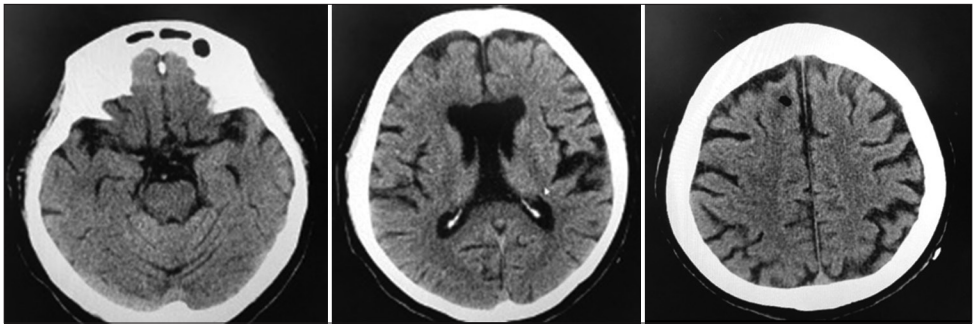

Figure 2: Head CT just after the operation. There are no visible signs of hemorrhage, infarction, or cerebral herniation.

Table 1: Summary of brainstem anesthesia cases in neurosurgery.

Case	Age, sex	Disease	Surgery	Anesthesia	Local anesthetics	Suspected access route to CSF	Timing of injection	Recovery time
Munis *et al*. (2006)	36M	Chiari Type I malformation	FMD	General+local	Bupivacaine	Opening in the suture line of duraplasty	After skin closure	76 min
Joannides *et al*. (2012)	15F	Chiari Type I malformation	FMD	General+local	Levobupivacaine	Opening in the suture line of duraplasty	After skin closure	2 h
Joannides *et al*. (2012)	16M	Chiari Type I malformation	FMD	General+local	Levobupivacaine	Opening in the suture line of duraplasty	After skin closure	3 h
Waters *et al*. (2017)	36F	Postoperative CSF leak	Suture of the dura	Local only	Lidocaine	Through dural defect	Beginning of operation	3 h
Current case (2020)	79F	NPH	VP shunt	General+local	Lidocaine/ bupivacaine	Through burr hole	During skin closure	1 h

CSF: Cerebrospinal fluid, FMD: Foramen magnum decompression, VP shunt: Ventriculoperitoneal shunt

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.

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Declaration of patient consent

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

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Conflicts of interest

There are no conflicts of interest.

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