Negative Pressure Epidural Syndrome as a Cause of Hemodynamic Instability in Children After Craniotomy

To JNA Readers:

Unexplained death after an eventful neurosurgical intervention is not rare, especially in pediatric patients. Many of these cases can be explained by negative pressure epidural syndrome. The use of negative pressure system for prevention of epidural or subgaleal blood collection is a common technique in neurosurgical procedures. Arbitrary use of this system can create several complications.1,2 In this article, we report 3 children who presented with hemodynamic instability after a neurosurgical operation.

Our first case was a 1-year-old boy. He was admitted to our department for elective correction of craniosynostosis. Immediately after connecting the negative pressure system, the patient developed bradycardia and hypotension that did not improve until the negative pressure was disconnected. The second case was a 2-year-old girl who underwent decompressive cranectomy. At the end, she was connected to the hemovacuum system. During her transport to ICU, she developed bradycardia and hypotension that progressed to asystole. Unfortunately, she passed away after 45 minutes of cardiopulmonary cerebral resuscitation.

There are 3 possible causes of this syndrome. Trigemino-cardiac reflex (TCR) has been suggested as a major cause of NPES. Karamchandani et al3 in 2006 reported 2 cases in which cardiovascular disturbance occurred at the end of craniotomy surgery after subgaleal vacuum drainage because of TCR. TCR is defined as the sudden onset of parasymptomatic overactivity, bradycardia, hypotension, apnea, and sometimes hypermotility of the stomach due to stimulation of the sensory branches of the trigeminal nerve.3 The sensory innervation of the meninges occurs primarily by meningeal branches of both the trigeminal and vagus nerves with a smaller contribution from the upper cervical spinal nerves. Sensory nerve endings of the trigeminal nerve send neuronal signals through the Gasserian ganglion to the sensory nucleus of the trigeminal nerve and then create afferent pathway that continues along the short interneural nerve fibers in the reticular formation to connect with the efferent pathway in the motor nucleus of the vagus nerve.4 Hence, stimulation of the meninges can trigger TCR and create bradycardia and asystole at the end of surgery when we have a light anesthesia. After careful review of our cases and review of other reported cases, it seems that upward transtentorial herniation is the second cause of NPES that we named it as lethal suction syndrome (LSS), especially in pediatric patients.5 The third possible cause of LSS can be start of bleeding from the previous hemostatic tissue that is sometimes more than the accepted amount of blood loss. This factor is more important in children with lower total blood volume and fragile soft tissue vasculatures.

In conclusion, LSS or NPES is very dangerous but it is a preventable event in neurosurgical patients, especially in children. Good and gentle hemostasis and not using negative pressure suction system or use of this system with careful control are major approaches for its prevention. LSS can also be triggered by very low negative pressure stimulation. Manipulation of dura in both infratentorial and supratentorial compartments can provoke this syndrome.

Mohammad S. Masoudi, MD
Bahar Noori, MD
Elabe Rezaee, MD
Maryam Tavakoli, MD
Department of Pediatric Neurosurgery
Shiraz University of Medical Sciences
Shiraz, Iran

ACKNOWLEDGMENT

The authors thank Shiraz University of Medical Sciences, Shiraz, Iran and also Center for Development of Clinical Research of Nemazee Hospital and Dr. Nasrin Shokrpour for editorial assistance.

REFERENCES