

Effect of anesthetic agent on brain volume: A transcranial sonographic assessment

Dear Editor,

A progressive reduction in brain volume begins at around 40-50 years of age and stops after the age of 86 years. However, decrease in whole-brain volume is solely not related to the ageing process. Anesthetic exposure is another factor associated with a loss of cerebral grey matter volume and the degree of postoperative cognitive dysfunction correlated with the extent of atrophy in the brain.^[1] Though magnetic resonance imaging (MRI) allows the *in vivo* quantification of brain volume,^[2] the third ventricular width (TVW) measured by transcranial sonography (TCS), as a marker of brain atrophy can reliably be used as surrogate tool for MRI to measure brain volume.^[3] Advantages with TCS is that it can be used as a bedside tool, does not require patient transfer to MRI suite, less time consuming and cost-effective. We present a series of ten patients in whom we assessed the effect of propofol infusion on TVW during brachial plexus injury surgery.

Written informed consents were taken and standard anesthesia protocol was followed for all. Median age for patients was 25.5 years, and all of them were males. After attaching all standard monitors and securing invasive lines, baseline TCS was performed before induction of anesthesia through the temporal acoustic bone window with low frequency ultrasound probe of 1-5 MHz frequency [Sonosite S-Nerve USA]. By

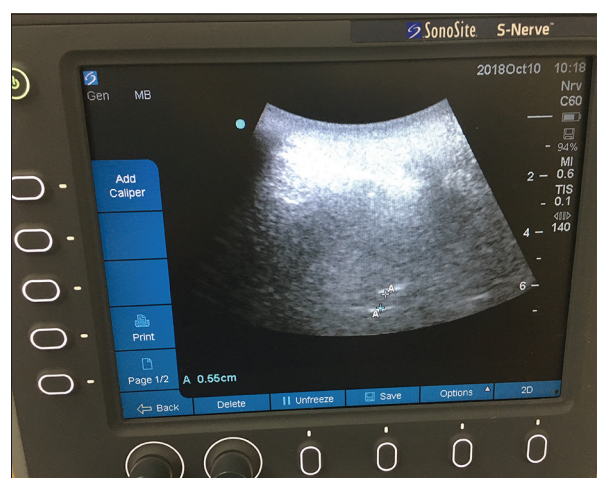


Figure 1: Shows the third ventricle as a double hyperechogenic image over the midbrain

Table 1: Third ventricular width [TVW] before and after total intravenous anesthesia

No. of patients	Duration of surgery [hrs]	TVW before induction [c.m]	TVW end of surgery [c.m]
1	5.15	0.39	0.41
2	5.15	0.22	0.28
3	2	0.16	0.36
4	8	0.20	0.31
5	4	0.12	0.33
6	6.3	0.56	0.64
7	5	0.42	0.51
8	6	0.23	0.65
9	5	0.40	0.49
10	5.3	0.42	1.14

tilting the probe with 10 degrees upward, we could appreciate the third ventricle in a depth of 6-8 cm in all patients. The

third ventricle was identified as a double hyperechogenic image over the midbrain [Figure 1]. The TVW was assessed as the maximum distance between the inner boundaries of both hyperechogenic lines after they appear strictly parallel. The measurement was performed from both sides of the head. Three readings were noted from both side from which the mean for each side is calculated. The definite final width of the third ventricle was taken as the mean of both sides. Throughout the procedure we kept PaCo₂ level between 35 to 40 mmHg. We also calculated the total duration of anesthesia exposure. Our results showed the increase in TVW in all patients in the end of the surgery irrespective of duration of surgery [Table 1]. One patient was excluded due to poor temporal acoustic window.

Irrespective of the duration of surgery in our patients we observed an increase in the TVW at the end of the surgery. We believe that the increase in TVW could possibly be due to TIVA owing to cerebral vasoconstriction caused by propofol leading to decrease/shrinkage in brain volume. TCS is an evolving field of brain ultrasound application for studying brain volume. Third ventricular enlargement is usually considered as a sign of brain atrophy^[4] and TVW as a marker of cognitive function.^[5] Cognitive decline after anesthesia is frequently observed in patients after major surgery. Since TVW is a marker of cognitive function, intraoperative TCS could be used as an important tool to assess the effect of anesthetic drugs on the incidence of postoperative cognitive function. Our case series reminds clinicians about this modality to assess the brain volume which is less time consuming and equally reliable. Further studies may be required to establish relationship between exposure of anesthetics affecting brain volume and cognitive functions.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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References

1. Backeljauw B, Holland SK, Altaye M, Loepke AW. Cognition and brain structure following early childhood surgery with anesthesia. *Pediatrics* 2015;136:1-12.
2. Keller SS, Roberts N. Measurement of brain volume using MRI: Software, techniques, choices and prerequisites. *J Anthropol Sci* 2009;87:127-51.
3. Wollenweber FA, Schomburg R, Probst M, Schneider V, Hiry T, Ochsenfeld A, *et al.* Width of the third ventricle assessed by transcranial sonography can monitor brain atrophy in a time- and cost-effective manner - Results from a longitudinal study on 500 subjects. *Psychiatry Res* 2011;191:212-6.
4. Berg D, Maurer M, Warmuth MM, Rieckmann P, Becker G. The correlation between ventricular diameter measured by transcranial sonography and clinical disability and cognitive dysfunction in patients with multiple sclerosis. *Arch Neurol* 2000;57:1289-92.
5. Benedict RH, Bruce JM, Dwyer MG, Abdelrahman N, Hussein S, Weinstock GB, *et al.* Neocortical atrophy, third ventricular width, and cognitive dysfunction in multiple sclerosis. *Arch Neurol* 2006;63:1301-6.

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