Abstract

**Title of the study**  Optic nerve sheath diameter (ONSD) measurements in normal subjects and patients undergoing cranioplasty after decompressive craniectomy for traumatic brain injury – A prospective observational cohort study

**Purpose of the study**  To evaluate and compare the change in measurements of optic nerve sheath diameter (ONSD) between Trendelenburg position (30 degree head down), supine and reverse Trendelenburg position (30 degree head elevation) in normal subjects and to evaluate and compare the change in measurements of optic nerve sheath diameter (ONSD) between Trendelenburg position (30 degree head down), supine and reverse Trendelenburg position (30 degree head elevation) in patients before and after cranioplasty.

**Methods**  This study was approved by institutional review board. This study is done in 2 groups. Normal healthy subjects working in the Department of Neurological Sciences in CMC Vellore and willing to volunteer for the study were included in the first study group. Patients who had undergone a decompressive craniectomy following traumatic brain injury are routinely screened in the Brain Injury Clinic and readmitted for cranioplasty. These patients were included as the 2nd study group. All the normal subjects and patients were included in the study after obtaining an informed consent. In the group 1 the mean ONSD in each position was calculated and comparison was made between values in each position using paired t-test. The mean ONSD value in the head end zero degree position was compared with the mean ONSD value in 30-degree head end elevation and 30-degree head down position. A p value of <0.05 was considered significant. The inter-observer variability was calculated for first 11 patient’s data using Intraclass correlation coefficient (ICC) test.
In the second group we calculated the variability of ONSD values between pre-operative period and the third post-operative period. Variability in ocular pressure across position (elevated and down) in pre and post-surgery period were summarized using range (maximum minus minimum) as a summary statistic or measure.

**Results** In the first study group all subjects were male and the mean age of the study group was 28 years. The mean ONSD value in 0 degree head end elevation was 5.02 ±0.15 and in 30-degree head end elevation and 30-degree head down position were 5.03±0.18 and 5.08±0.16 respectively. When the mean ONSD value in 0 degree head elevation was compared with that of 30 degrees head end elevation using paired t-test, the p-value was 0.6817 which indicates that the difference in the values was not significant. Comparing the ONSD in 0 degrees head position with 30 degree head down position the p-value was 0.060 again showing that the differences between values in these two positions are not significant. Overall analysis showed that there was no significant difference in the ONSD values in three different head end positions. In the second group variability in ONSD measurement across positions (supine, elevated and down) in pre and post-surgery period were summarized using range (maximum minus minimum) as a summary statistic or measure. Seventeen patients showed a negative change (decrease in range after surgery, and 12 patients showed a positive change (increase in range after surgery).

In 17 patients the variability decreased from 0.14 mm (head up 5.09 mm, head down 5.23 mm) to 0.07 mm (head up 5.14, head down 5.21). In the remaining 12 patients the variability increased from 0.11 mm (head up 4.88 mm, head down 4.99 mm) to 0.13 mm (head up 4.89, head down 5.02). In supine position three patients (10.34%) patients had full flaps and in the rest of the patients (89.66%) the flaps were sunken. When these three patients were positioned with a 30degree head end elevation it was found that in two of them the craniectomy flap changed from
the full position to sunken position. When the 26 patients who had a sunken flap at 0degree head elevation position were made to lie down in a 30degree head down position, 24 (92.3%) patients’ flaps changed from the sunken to full position

**Conclusion** In normal subjects the optic nerve sheath diameter does not decrease on head end elevation, and the increase on lowering the head end falls short of significance. Sinking of the craniectomy scalp flap in supine or in head end elevated position is not associated with raised ICP. Therefore it is not possible to attribute any improvement in clinical status after cranioplasty to a removal of the effect of atmospheric pressure and a decrease in ICP.

The effect of cranioplasty on intracranial pressure dynamics in our study is mixed and cannot explain any change in clinical status

**Key words** ONSD, ICP, variability, Trendelenburg position, reverse Trendelenburg position.