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The Effect of Laryngoscope Types on Hemodynamic Response and Intracranial Pressure by ONSD Measurement in Neurosurgery at Sanglah General Hospital: A Case Series

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ABSTRACT

Object: Endotracheal intubation is the gold standard for ensuring a safe airway when applying general anesthesia. Endotracheal intubation can cause an increase in intracranial pressure (ICP). Ultrasound measurement of optic nerve sheath diameter (ONSD) is known as an accurate monitor of increased intracranial pressure. However, it is not known how the ICP fluctuations are caused by endotracheal intubation using various types of laryngoscopy. Therefore, the authors investigated the hemodynamic changes and intracranial pressure caused by the two types of laryngoscopes used for endotracheal intubation in neurosurgical patients undergoing general anesthesia.
Cases: The authors report 4 patients as a case series from the Central Operating Theatre (COT) of Sanglah General Hospital, Denpasar, Bali. We were performed optical nerve sheath diameter (ONSD) measurements on both eyeballs of those patients. All of the patients were performed general anaesthesia with endotracheal intubation. Correlation between ONSD and ICP measurements was determined, and changes were seen based on baseline data obtained from before intubation to 10 minutes after intubation. Sheath diameter more than 5.5 mm had a higher ICP value predicate than 15 mmHg with 100% sensitivity (95% CI, 100-100) and 100% specificity (95% CI, 100-100).
Discussion: Our case series demonstrated a change in ICP in each patient endotracheal intubation with a McGrath video laryngoscope and a Macintosh laryngoscope, then the authors examined the optic nerve sheath by performing ultrasonography after induction before intubation (T0), 1 minute (T1), 3 minutes (T3), 5 minutes (T5) and 10 minutes after intubation (T10), which is known to increase ICP. In all patients ICP increased above normal values in baseline. There was a difference in diameter between the right and left eyes according to the location of each tumor. During tracheal manipulation, at first minute there was an increase in diameter in both eyes with ONSD increasing > 0,5 mm from the baseline value, and starting to decrease at 3, 5 minutes, and approaching or equal to the baseline value at 10 minutes.
Conclusion: In neurosurgical patients undergoing general anesthesia with endotracheal intubation, laryngoscopy is unavoidable, the use of the type of laryngoscope should be carefully considered in order to select and use a better type of laryngoscope to prevent hemodynamic shock. Hemodynamic monitoring with patient monitors and ONSD ultrasonography is an accurate, simple, and rapid measure to detect ICP elevations and ICP changes in real time. Therefore, ONSD could be a useful tool for monitoring ICP, especially in conditions where invasive ICP monitoring is not available.

***Keywords**: laryngoscope, hemodinamik, intracranial, ONSD, neurosurgery*

INTRODUCTION

Endotracheal intubation is an act of securing the airway by placing a tube through the trachea. This procedure is performed on patients who have a compromised airway, are unable to maintain an airway in an emergency or to facilitate a general anesthetic for surgery. In general, anesthesia is carried out by an expert in the field, including an anesthesiologist.

Tracheal intubation is usually facilitated by direct laryngoscopy; however, a variety of alternative intubation devices and techniques have been developed to avoid the problems encountered when conventional direct laryngoscopy is difficult.[1] Endotracheal intubation is still possible to stimulate the supraglottic region during laryngoscopy which causes an increase in plasma catecholamine concentrations due to activation of the sympathoadrenal system. After laryngoscopy and intubation, a transient (approximately 5 min) increase in heart rate (HR), blood pressure and intraocular pressure as well as intracranial pressure (ICP) and undesirable effects such as arrhythmias and bronchoconstriction may occur.[2]

Standard hemodynamic monitoring for each patient uses a digital monitor that displays data on blood pressure, pulse, pulse oximeter, ECG, EtCO2 and respiratory rate. ICP measurement can be done by two methods, namely intensive or non-intensive. One of the non-intensive methods that I will use is the measurement of the diameter of the optic nerve sheath. ONSD measurements in patients were carried out with their eyes closed using ultrasound with a linear probe and a frequency of 7.5-10 mHz. The patient's eyelids were wrapped in sterile plastic and smeared with ultrasound jelly. Then the probe is placed transversely over the patient's eyelid, after measuring the posterior 3mm of the eyeball, use an electronic caliper to measure the distance of decreasing echogenicity between the hyperechoic separation margins on the sheath.[3]

CASE SERIES

This study is retrospective in nature. All cases were conducted at Sanglah General Hospital between March and April 2022. Cases included in this study were patients with American Society of Anesthesiologists physical status I – III, aged 18 – 65 years old, undergoing elective neurosurgery under general anesthesia. In this study, the patients with uncontrolled hypertension, traumatic brain injury, decreased of consciousness pre-operative and mallampati class more than 2 were excluded.

Types of laryngoscope and endotracheal intubation was selected and carried out by the anesthesiologist that in charge of the patient. Every patient who meets the requirements to be included in this case series is subjected to an initial examination of the physical status of ASA and mallampati in the inpatient room. After the patient is ready, the patient is placed on an invasive hemodynamic monitoring device (such as an arterial line). The types of laryngoscope used in this case series are McGrath video laryngoscope and Macintosh direct laryngoscope. The use of the direct laryngoscope has been around for a long time, and has become the laryngoscope that commonly used by anesthesiologists. Meanwhile, McGrath video laryngoscope is a type of video laryngoscope which is an innovation of intubation aids that has developed in recent decades.

The selection of drugs when the patient is induced by anesthesia is carried out by the anesthesiologist in charge of the patient in accordance with the standard regimen for anesthesia of neurosurgery patients (the principle of neuroanaesthesia). At the time after induction, before intubation, hemodynamic measurements and ONSD were taken as baseline data. then, after endotracheal intubation the patient was again measured for hemodynamics and ONSD at 1, 3, 5 and 10 minutes, respectively.

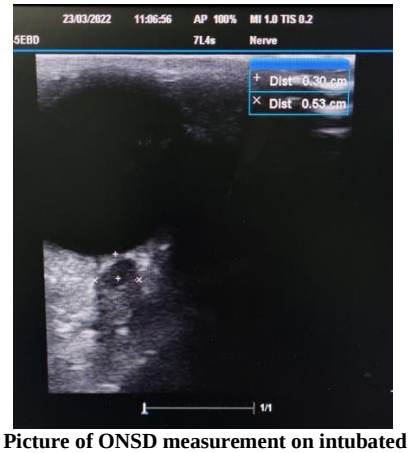

Figure 1. Picture of ONSD measurement on intubated patient during general anaesthesia.

Case 1

A 56 years old male, ASA physical status III with extra-axial tumor in the middle region of the left fossa with suspected meningioma post craniotomy tumor removal stage 1 presented for second stage craniotomy and tumor removal. Patient with mallampati I, intubated with Macintosh direct laryngoscope on head up position, Cormack-Lehane 2, induced with anaesthesia regimen for induction Propofol TCI target effect 3-4, Fentanyl 2,5 mcg/ KgBW IV, Lidocaine 1,5 mg/ KgBW IV and Rocuronium 0,8 mg/ KgBW IV. Hemodynamics and ICP monitoring in this patient were showed in the table 1.

	ONSD		MAP (mmHg)	HR (bpm)
	Right eye (mm)	Left eye (mm)		
T0	5,2	5,7	83	54
T1	5,8	6,2	136	78
T3	5,7	6,1	92	61
T5	5.5	6,0	90	58
T10	5,2	6,0	91	54

Table 1. Hemodynamics and ONSD result

Case 2

A 65 years old female, ASA physical status III with multiple intra-axial tumors temporoparietal region sinistra suspected high grade glioma presented for craniotomy tumor resection. Patient with mallampati II, intubated with McGrath video laryngoscope on head up position, Cormack-Lehane 1, induced with anaesthesia regimen for induction Propofol TCI target effect 3-4, Fentanyl 2,5 mcg/ KgBW IV and Rocuronium 0,8 mg/ KgBW IV. Hemodynamics and ICP monitoring in this patient were showed in the table 2.

	ONSD		MAP (mmHg)	HR (bpm)
	Right eye (mm)	Left eye (mm)		
T0	5.5	5.8	115	52
T1	6.1	6.3	118	56
T3	5.9	5.8	105	52
T5	5.5	5.7	98	51
T10	5.5	5.8	96	53

Table 2. Hemodynamics and ONSD result

Case 3

The third patient male 52 years old, ASA physical status II with extra-axial tumor of the left parietooccipital region suspected soft tissue sarcoma presented for open biopsi. Patient with mallampati II, intubated with Macintosh direct laryngoscope on head up position, Cormack-Lehane 1, induced with anaesthesia regimen for induction Propofol TCI target effect 3-4, Fentanyl 2,5 mcg/ KgBW IV, Lidocaine 1,5 mg/ KgBW IV and Rocuronium 0,8 mg/ KgBW IV. Hemodynamics and ICP monitoring in this patient were showed in the table 3.

	ONSD		MAP (mmHg)	HR (bpm)
	Right eye (mm)	Left eye (mm)		
T0	4.9	5.1	66	56
T1	5.5	5.8	78	65
T3	5.4	5.7	75	60
T5	5.3	5.5	74	59
T10	5.0	5.2	70	55

Table 3. Hemodynamics and ONSD result

Case 4

A 39 years old male, ASA physical status III with suprasellar region extra axial tumor suspected pituitary macroadenoma presented for tumor resection with transphenoidal approach. Patient with mallampati I, intubated with McGrath video laryngoscope on head up position, Cormack-Lehane 2, induced with anaesthesia regimen for induction Propofol TCI target effect 3-4, Fentanyl 2,5 mcg/ KgBW IV, Lidocaine 1,5 mg/ KgBW IV and Rocuronium 0,8 mg/ KgBW IV. Hemodynamics and ICP monitoring in this patient were showed in the table 4.

	ONSD		MAP	HR
	Right eye (mm)	Left eye (mm)	(mmHg)	(bpm)
T0	5.4	5.5	75	57
T1	6.1	6.1	89	75
T3	5.9	5.9	85	74
T5	5.7	5.8	75	65
T10	5.6	5.7	74	59

Table 4. Hemodynamics and ONSD result

DISCUSSION

Changes in hemodynamics and ONSD are a response to laryngoscopy and intubation, under certain conditions these changes in hemodynamics and ONSD can cause a more serious problem because of the increase in hemodynamics and ONSD in cases of cardiovascular, cerebral aneurysms and intracranial hypertension.[4, 5]

When comparing the two new and old tools, we have to see how often the new tools are used so as not to create bias in this case. In our operating room, there are several types of intubation aids, one of which is the McGrath video laryngoscope and the Macintosh direct laryngoscope. McGrath video laryngoscope has been around for about 3 years and has become a tool that is often used and recommended for intubating patients with predictably difficult airways because of the visualization of the larynx is somewhat better with the McGrath laryngoscope compared to the Macintosh. [6]

The results in this study are similar to a study in Turkey comparing hemodynamic response and ONSD after intubation with a McCoy, Macintosh, and C-MAC video-laryngoscope, in that study there was no statistically significant difference in hemodynamic changes and ONSD in all groups, but it was found that each group experienced an increase in the first minute (T1) compared to before intubation (T0). [7]

ONSD after intubation with both types of laryngoscopes in this study did not indicate the occurrence of an intracranial hypertension because the upper limit set by several existing studies stated that a value of about 5.5 mm was the upper limit of the normal value for ICP which was stated in the study by Amini, et al. (2013) that the mean sonographic diameter of the optic nerve sheaths of both eyes was 5.18 ± 1.03 mm, without a significant relationship with the age and sex of the patient. And it was also explained there that the sheath diameter more than 5.5 mm had a predicate ICP value higher than 20 cmH2O with 100% sensitivity (95% CI, 100-100) and 100% specificity (95% CI, 100-100). Where in conditions of increased ICP the mean value of ONSD was 6.66 ± 0.58, and under normal conditions of ICP, the mean value of ONSD was 4.60 ± 0.41 (range, 3.8-5.4) mm. [8]

CONCLUSION

Both of two types laryngoscope on this study was increase hemodynamics and ICP, especially in the 1st minute after intubation when compared to the time before intubation. in both types of laryngoscope increased HR and MAP especially at 1 minute (T1) and began to decrease at 3 minutes (T3) to 10 minutes (T10) after intubation with the HR and MAP were close to the initial values at the time before intubation. ONSD was measured in both the patient's eyeballs (right and left), the difference in right and left diameters may be due to the presence of a tumor in that area. comparison at T0 and T1 showed a significant increase in diameter and indicated an increase in ICP in the first minute after intubation in all of the above patients. This shows that both types of laryngoscopes do affect hemodynamics and ICP, but the increase is not significantly high, so the patient does not experience an intracranial hypertension. A further analytical study is needed regarding the use of laryngoscope to hemodynamics and ICP response associated with larynx manipulation during laryngoscopy and endotracheal intubation.

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Conflict of Interest: None

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