Effects of proseal laryngeal mask airway cuff inflation on carotid flow in pediatric population during sevoflurane induction

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Key points
The laryngeal mask cuff inflation can exert a pressure and a displacement on the neck vessels and determine a potential change of the carotid flow. No study has been never performed in pediatric patients. The variation of the carotid flow was studied on a group of pediatric patients during the phase of sevoflurane induction.

Abstract
Introduction
The study examined the effects of cuff inflation of a ProSeal Laryngeal Mask Airway on the carotid bulb during sevoflurane induction in pediatric population. The hemodynamic parameters measured were: systolic and diastolic pressure, heart rate and sovraortic flow trough measurements of bilateral carotid cross sectional area, velocity of blood flow, resistance index, flow acceleration, systolic and diastolic peak velocity, all at the level of the carotid bulb before and after cuff inflation.

Materials and Methods
The measurement of some hemodynamic parameters (cross-sectional area carotid artery, resistance index, carotid flow acceleration, sistolic and diastolic peak velocity) were performed bilaterally before and after laryngeal mask cuff inflation by ultrasound at the level of the carotid artery bulb during sevoflurane induction.

Results
Results showed a significant variation of systemic hemodynamic parameters before and after laryngeal mask cuff inflation while no significant variation was obtained for sovraortic hemodynamic blood flow.

Conclusion
The results demonstrated that in children during sevoflurane induction, differently from the only study described in literature as case report on a single adult patient, laryngeal mask cuff inflation does not reduce or change the carotid flow.

Keywords: laryngeal mask airway, pediatric, hemodynamic monitoring, ultrasound, carotid flow

Introduction
The use of laryngeal mask airway (LMA) is common in anesthesia clinical practice in adult and pediatric patients [1]. The ProSeal Laryngeal Mask Airway (PLMA) can be considered a replacement device for the Classic LMA with major advance for several reasons: it allows ventilation at much higher airway pressures, protects the lungs from aspiration and the stomach from gastric insufflation, facilitates the passage of a gastric tube and in some cases allows the insertion of hemodynamic...
monitoring devices into the esophagus as described by Galante with the innovative technique called TED-PLMA [2, 3]. Moreover, it can be inserted like the Classic LMA, has its own built-in bite block and malposition is detected more readily [4].

No study has demonstrated the hemodynamic impact of PLMA cuff inflation in pediatric population undergoing general anesthesia using this device and no data are available about the hemodynamic changes in sovraortic flow before and after the cuff inflation of the PLMA. The only study described in literature is about a case report in adult patient [5].

This study examined the effects of cuff inflation on the systolic and diastolic pressure, heart rate and sovraortic circulation trough measurements of bilateral carotid cross sectional area, velocity of blood flow, resistance index, flow acceleration, systolic and diastolic peak velocity, all at the level of the carotid bulb before and after cuff inflation.

**Materials and methods**

The study was performed after the institutional ethic committee approval.

We enrolled 26 children, 22 males and 4 females with age range between 2 and 11 years old (average: 4.76 years), weighing between 9 and 56 kg (mean: 25.04 kg).

We used a PLMA with variable sizes from 1.5 to 3.0 depending on the ideal weight of the patient. The induction of anesthesia was performed with a mixture of air/oxygen and sevoflurane (FiO$_2$ 0.4 and sevoflurane 8%). Peripheral venous access was obtained and fentanyl administered (2 $\gamma$/ kg ) without any curarization.

The measurement of some hemodynamic parameters (cross-sectional area carotid artery, resistance index, carotid flow acceleration, sistolic and diastolic peak velocity) were performed bilaterally before and after laryngeal mask cuff inflation by ultrasound (Sonosite 180 Plus, linear probe 5 - 10 MHz) at the level of the carotid artery bulb during the induction of anesthesia (Figures A, B).

Standard respiratory and hemodynamic parameters such as SpO$_2$, EtCO$_2$, systolic artery pressure (SAP), diastolic artery pressure (DAP) and heart rate (HR) were recorded.

**Statistical analysis**

About statistical analysis we compared the hemodynamic and respiratory parameters before and after laryngeal mask cuff inflation. Statistical analysis was performed using Microsoft Office Excel program and the Student t-test for paired samples. A P-value < 0.05 was considered as significant.
Results
The results have been described on the graphs illustrated in Figures 1-12 that show the trend of the parameters measured before and after laryngeal mask cuff inflation. We considered two main groups of clinical parameters: systemic hemodynamic parameters (systolic artery pressure, diastolic artery pressure and heart rate) and sovraortic hemodynamic parameters (bilateral carotid cross sectional area, velocity of blood flow, resistance index, flow acceleration, systolic and diastolic peak velocity at the level of the carotid bulb).

Results show a significant variation of systemic hemodynamic parameters before and after laryngeal mask cuff inflation (Figures 1 and 2), while no significant variation was obtained for sovraortic hemodynamic data (Figures 3-12).

Figure 1. Systolic and diastolic artery pressure (PAS/PAD) before (t) and after cuff inflation (t + 1).
Figure 2. Heart rate before (t) and after cuff inflation (t + 1).
Figure 3. Resistance Index Dx before (t) and after cuff inflation (t + 1).
Figure 4. Resistance Index Sx before (t) and after cuff inflation (t + 1).
Figure 5. Cross sectional area dx before (t) and after cuff inflation (t + 1).
Figure 6. Cross sectional area sx before (t) and after cuff inflation (t + 1).
**Discussion and conclusion**

The statistical analysis of systemic hemodynamic data has been demonstrated that the variation of these parameters before and after the laryngeal mask cuff inflation turns out to be statistically significant (p <0.05), while the second group of data about the evaluation of hemodynamic carotid flow was not significant. The mismatch of changes between systemic hemodynamic parameters and parameters related to the sovraortic flow could be explained by the depth of anesthesia induced by sevoflurane which determine a reduction of all systemic hemodynamic parameters (HR, SAP and DAP) but in the same time has not influenced the sovraortic hemodynamic parameters.

The variation of HR, SAP and DAP can also be related to the considerable variability observed physiologically in different age groups of children but it’s not significant if we take as reference the analysis of specific hemodynamic parameters measured on the right and left carotid artery before and after laryngeal mask cuff inflation.
These results demonstrate that in children, differently from the only study described in literature as case report on a single adult patients [5], laryngeal mask cuff inflation does not reduce carotid flow. The use of PLMA can therefore be considered safe in the pediatric age and during sevoflurane induction even when used at high concentrations.

References