Pediatric Anesthesia and Critical Care Journal 2016;4(2):112-116
doi:10.14587/paccj.2016.23

PACCJ

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

D. Galante[1], V. Benenati[2], G. Accurso[2], M. S. Lambo[3], L. Cococcia[4], M. Caruselli[5]

[1]University Department of Anesthesia and Intensive Care, University Hospital Ospedali Riuniti, Foggia, Italy
[2]University Department of Anesthesia and Intensive Care, Paolo Giaccone University Hospital, Palermo, Italy
[3]Department of Anesthesia and Intensive Care, Spirito Santo Hospital, Pescara, Italy
[4]Department of Anesthesia and Intensive Care, SS. Annunziata Hospital, Sulmona (AQ), Italy
[5]Department of Anesthesia and Intensive Care, La Timone Children's Hospital, Marseille, France

Corresponding author: D. Galante, University Department of Anesthesia and Intensive Care, University Hospital Ospedali Riuniti, Foggia, Italy. Email: dario.galante@tin.it

Keypoints

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 laryngeal mask cuff inflation can exert a pressure and a displacement on the neck vessels and determine a potential change of the carotid flow. The study examined the effects of cuff inflation of a ProSeal Laryngeal Mask Airway on the carotid bulb during sevoflurane induction in pediatric population.

Materials and Methods

The measurement of some hemodynamic parameters (cross-sectional area carotid artery, resistance index, carotid flow acceleration, systolic and diastolic peak velocity, SDR [S/D Ratio: Systolic Peak Velocity / End Diastolic Velocity]) were performed bilaterally before and after laryngeal mask cuff inflation by color Doppler ultrasound at the level of the carotid artery bulb during sevoflurane induction in pediatric patients undergoing surgery.

A ProSeal laryngeal mask was used in this study as it has a better leak pressure versus the classic laryngeal mask airway.

Results

Results showed that there was no clinically and statistically significant variation in measured parameters before and after laryngeal mask cuff inflation

Conclusion

The results demonstrated that in children during sevoflurane induction, differently from other studies described in literature, laryngeal mask cuff inflation does not reduce or change the carotid flow and all other hemodynamic parameters.

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

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. Only two old studies have been described in literature by Colbert but in adult patients [5,6].

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, SDR (S/D Ratio: Systolic Peak Velocity/End Diastolic Velocity) 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 25 children, 21 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) undergoing surgery for cryptorchidism, hydrocele, hernia, phimosis, acute torsion of the testicle. 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 up to 8 %). Peripheral venous access was obtained and no opioids or muscle relaxants were administered before the measurement.

The measurement of some hemodynamic parameters (cross-sectional area carotid artery, resistance index, carotid flow acceleration, systolic and diastolic peak velocity, S/D Ratio [Systolic Peak Velocity/End Diastolic Velocity]) were performed bilaterally before and after laryngeal mask cuff inflation by ultrasound color power Doppler (Sonosite 180 Plus, linear probe 5 - 10 MHz) at the level of the carotid artery bulb during the sevoflurane 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.

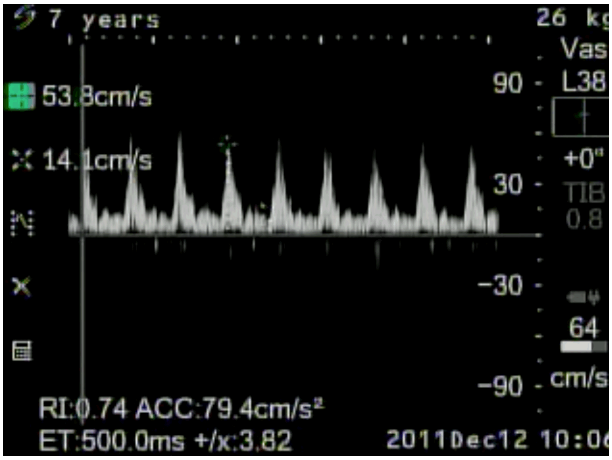

Figure A. Ultrasound carotid flow measurement

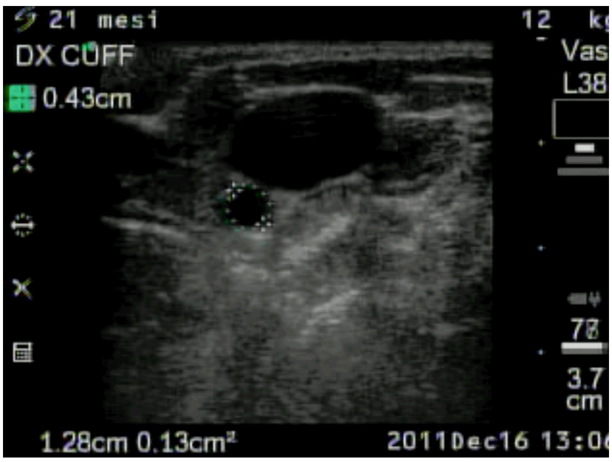

Figure B. Ultrasound carotid size measurement

Results

The results have been described on the graphs illustrated in Figures 1-12 and Table 1 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 and SDR at the level of the carotid bulb. Results show no clinically and statistically significant changes of systemic hemodynamic parameters before and after laryngeal mask cuff inflation (Figures 1 and 2), and no clinically and statistically significant variation for sovraortic hemodynamic data (Figures 3-12, Table 1).

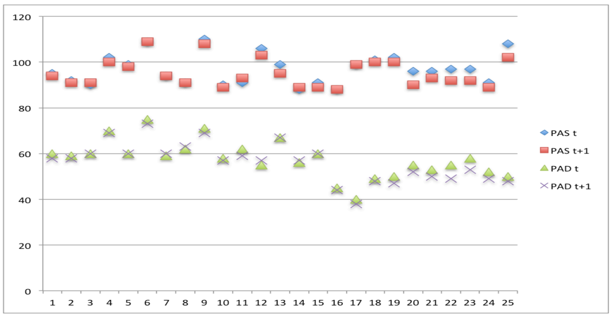

Figure 1. Systolic and diastolic artery pressure (PAS/PAD) before (t) and after cuff inflation (t + 1).

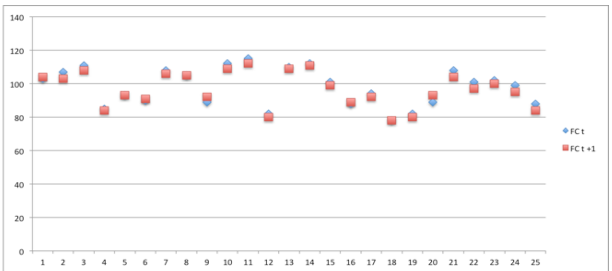

Figure 2. Heart rate before (t) and after cuff inflation (t + 1).

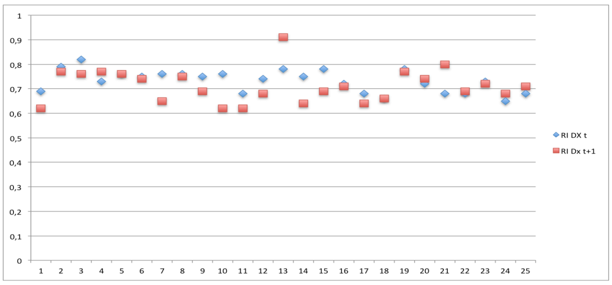

Figure 3. Resistance Index Dx before (t) and after cuff inflation (t + 1).

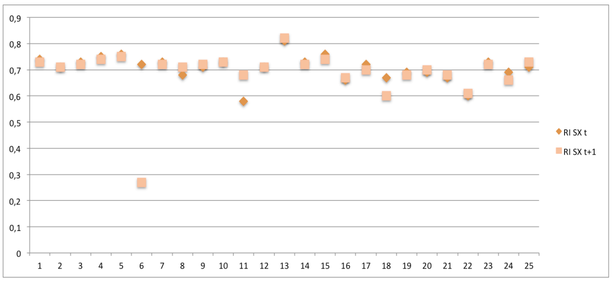

Figure 4. Resistance Index Sx before (t) and after cuff inflation (t + 1).

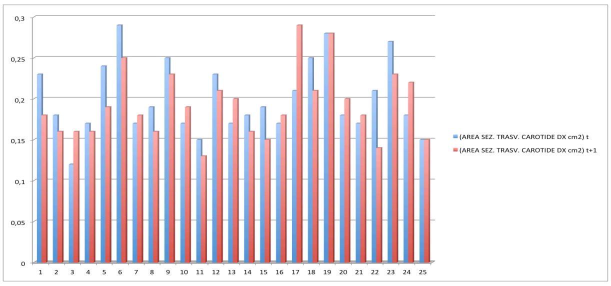

Figure 5. Cross sectional area dx before (t) and after cuff inflation (t + 1).

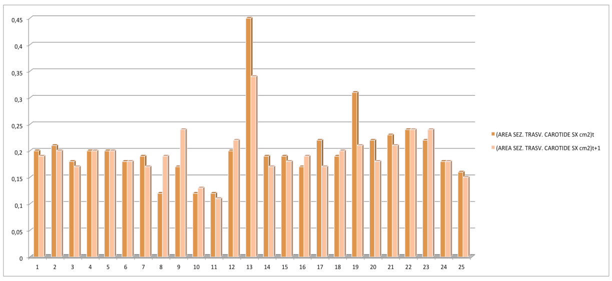

Figure 6. Cross sectional area sx before (t) and after cuff inflation (t + 1).

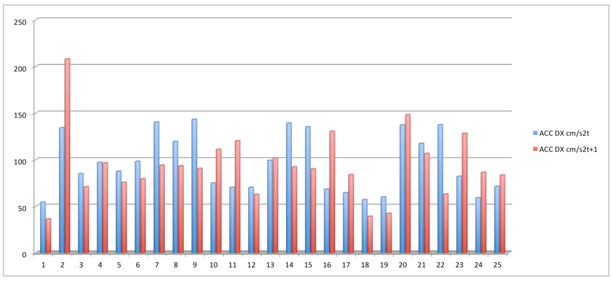

Figure 7. Carotid Flow Acceleration Dx before (t) and after cuff inflation (t + 1).

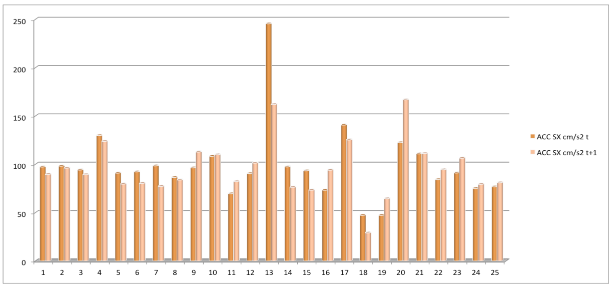

Figure 8. Carotid Flow Acceleration Sx before (t) and after cuff inflation (t + 1).

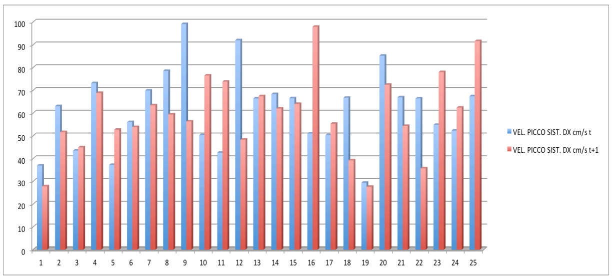

Figure 9. Systolic Peak Velocity Dx before (t) and after cuff inflation (t +1).

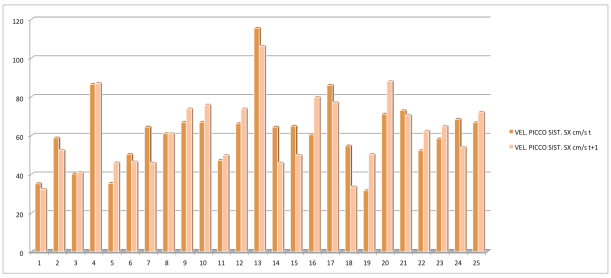

Figure 10. Systolic Peak Velocity Sx before (t) and after cuff inflation (t +1).

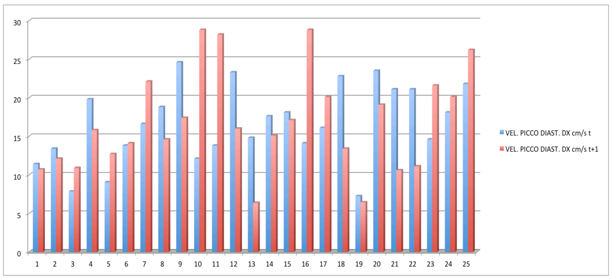

Figure 11. Diastolic Peak Velocity Dx before (t) and after cuff inflation (t + 1).

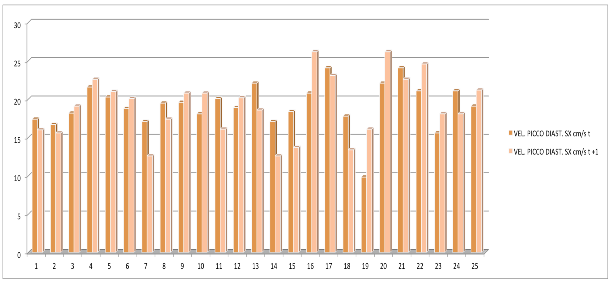

Figure 12. Diastolic Peak Velocity Sx before (t) and after cuff inflation (t +1).

SYSTOLIC AND DIASTOLIC VELOCITY	SDR
Systolic Peak Velocity Dx before inflation End Diastolic Velocity Dx before inflation	3.69
Systolic Peak Velocity Dx after inflation End Diastolic Velocity Dx after inflation	3.54
Systolic Peak Velocity Sx before inflation End Diastolic Velocity Sx before inflation	3.2
Systolic Peak Velocity Sx after inflation End Diastolic Velocity Sx after inflation	3.21

Table 1. SDR (S/D Ratio: Systolic Peak Velocity / End Diastolic Velocity) of right and left carotid artery before and after laryngeal mask inflation.

Discussion and conclusion

The statistical analysis of systemic and carotid hemodynamic data have been demonstrated that the changes of these parameters before and after the laryngeal mask cuff inflation turns out to be statistically and clinically-significant ($p < 0.05$).

We only observed a very and not significant light decrease in systemic hemodynamic parameters and sometime in carotid flow thht could be explained by the depth of anesthesia induced by sevoflurane which determine a reduction af all systemic hemodynamic parameters (HR, SAP and DAP) but without influence on 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.

Moreover, the SDR values obtained showed a remarkable stability of carotid flow that leaves non doubt about the poor influence of the LMA (Table 1).

These results demonstrated that in children, differently from the results reported in literature by Colbert [5,6] on adult patients, that 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.

The limitation to this study could be due to the fact that the pediatric population we studied referred to different age and weight ranges and using laryngeal masks of different sizes.

It would be more useful and interesting to study these hemodynamic changes on a larger homogeneous pediatric population with the same age, weight and LMA size.

References

1. Patel A, Clark SR, Schiffmiller M, Schoenberg C, Tewfik G. A survey of practice patterns in the use of laryngeal mask by pediatric anesthesiologists. Paediatr Anaesth 2015;25:1127-31
2. Galante D. Transesophageal Doppler Probe and Proseal Laryngeal Mask Airway. A New Technique for Probe Insertion in Pediatric Anesthesia. Anesthesia & Analgesia 2008;107:348)
3. Galante D. The Proseal laryngeal mask airway and the transesophageal Doppler probe: the TED-PLMA Technique. Can J Anaesth 2011; 58:1144–1145
4. Brimacombe J, Keller C, Berry A. Gastric insufflation with the ProSeal laryngeal mask. Anesth Analg 2001;92:1614-5.
5. Colbert S, O'Hanlon DM, Page R, Flanagan F, Moriarty D. Haemodynamic changes with the laryngeal mask airway - off the cuff. Eur J Anaesthesiol 1997;14:514-7.
6. Colbert SA, O'Hanlon DM, Flanagan F, Page R, Moriarty DC. The laryngeal mask airway reduces blood flow in the common carotid artery bulb. Can J Anaesth 1998;45:23-7.