

Assessment of the effect of CO₂ insufflation on regional Cerebral Oxygen Saturation using Near InfraRed Spectroscopy in children undergoing robotic-assisted laparoscopic pyeloplasty (RALP)

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Background

The dissemination of minimally invasive urological surgery in the pediatric population has prompted enhanced monitoring to evaluate the effects of carbon dioxide insufflation (CDI) on hemodynamics, respiratory function and Cerebral Oxygen Saturation (CrSO₂) during laparoscopy. In children undergoing robotic-assisted laparoscopic pyeloplasty (RALP), we assessed the effects of CDI on cardiorespiratory vital parameters and cerebral Near- InfraRed Spectroscopy, which provides a continuous non-invasive monitoring of CrSO₂. The second aim was to evaluate the correlation between CrSO₂ and standard parameters affecting cerebral blood flow (CBF), namely End Tidal CO₂ (EtCO₂) and Mean Arterial Pressure (MAP).

Methods: Between January 2021 and September 2022, a cohort of consecutive children undergoing RALP at Necker Enfants Malades Hospital of Paris was prospectively constituted. Data collected, reported as mean±SD, included demographics, ASA classification, CrSO₂ and standard hemodynamic and respiratory parameters. Correlation's analysis was performed using the Pearson's coefficient.

Results: Twenty-eight patients (16 females), mean age 5.3 ± 3.9 years, mean body weight 22.6 ± 12.0 Kg were included. Twenty-two patients underwent a retroperitoneal approach. The mean baseline CrSO₂ value was 82.0±7.3%. Mean CrSO₂ values increased at induction of anesthesia, slightly decreased during progressive CDI, reached a plateau during surgery and returned to baseline after trocars removal. Standard monitoring didn't notice any significant change in standard parameters during surgery (Table 1). No significant correlation was observed between CrSO₂ and EtCO₂, or between CrSO₂ and MAP, at any operative time.

Conclusion

During RALP, the progressive CDI using 12-mmHg pressure and 5 l.min⁻¹ flow doesn't cause

significant changes of CrSO₂. The lack of correlation between CrSO₂ and standard monitoring parameters affecting CBF suggests that cerebral autoregulation was maintained in our population. However, in infants and fragile children, whose brain self-regulation ability is not clearly defined, the lack of adverse effect of CDI has still to be demonstrated.

Table 1.

Variable	T1	T2	T3	T4	T5	T6	T7	T8
Heart Rate (beats/min)	106 ± 19.7	108 ± 18.0	100 ± 15.4	101 ± 15.9	103 ± 13.9	105 ± 13.4	104 ± 12.0	105 ± 15.5
MAP (mmHg)	73 ± 11.2	63 ± 11.1*	59 ± 7.6*	69 ± 13.7	71 ± 10.3	69 ± 9.2	65 ± 10.6	65 ± 8.5
EtCO ₂ (mmHg)	-	39 ± 5.1	37 ± 3.6	39 ± 4.7	41 ± 5.0	42 ± 4.8	39 ± 2.7	-
Body Temperature (°C)	-	36.4 ± 0.4	36.2 ± 0.5*	36.1 ± 0.6*	36.3 ± 0.7*	36.9 ± 0.6*	37.1 ± 0.4*	37.1 ± 0.4*
CrSO ₂ (%)	82 ± 7.3	90 ± 7.3*	86 ± 9.8*	85 ± 10.8*	86 ± 10.1*	85 ± 10.6*	86 ± 10.5*	87 ± 10.7*

Mean ± SD; * p < 0.05, from random-intercept linear regression models [reference: T1 (baseline), T2 (end of induction), T3 (patient positioning), T4 (trocar insertion), T5 (start of CDI), T6 (45 minutes after CDI), T7 (exsufflation), T8 (end of surgery)]

MAP: Mean Arterial Pressure; EtCO₂: End Tidal CO₂; CrSO₂: Cerebral Oxygen Saturation