

Hypoxic pulmonary vasoconstriction: Physiology and anesthetic implications

Del Gaudio A. MD, Recchia A. MD, N. De Nittis MD

Casa Sollievo della Sofferenza San Giovanni Rotondo Italy

Rationale: Laparoscopic surgery is considered the new frontier in the treatment of the urologic and abdominal patients. Crucial aspects in this treatment are supine with steep Trendelenburg (>30%) and head down position with impairment of diaphragmatic movements and ventilation increases of intracranial and intraocular pressure, increased load on cardiovascular system. Our study focuses the role of the decrease of pulmonary compliance in this surgery and evaluates the role of the anesthetic practice.

Methods: The study was approved by the local ethics committee and the patients had given their informed consent. The study population was formed by 24 patients undergoing to laparoscopic prostatectomy. The patients were divided in two groups: Group I performed intravenous anesthesia with Propofol/TCI and Remifentanil/TCI (P/R); Group G performed inhalational anesthesia with Sevoflurane and Remifentanil/TCI. In both the groups cerebral activity was monitored to guarantee a BIS value of 40. During surgery were evaluated PaO₂ and PaCO₂ at T0 with the patient in supine position, T1 with the patient in trendelenburg position and T2 during the laparoscopic phase. Mechanical ventilation was evaluated monitoring inspiratory peak level at the same time. Aldrete score was evaluated at the end of surgery.

Results: Our data underline a best compliance of the respiratory system in I Group with a significative increase of PaO₂ in the 3 times considered (fig.1), PaCO₂ decrease in the IG respect GG at T0 and T1 (fig.2). The inspiratory peak level was lower in the IG respect the GG (fig.3).

Discussion: On the basis of the actual knowledge it is possible to evaluate this condition as the reduction of hypoxic pulmonary vasoconstriction (HPV) (1). HPV corrects arterial oxygen saturation in a patient with ventilation/perfusion mismatch.(fig.4) Many drugs used in anesthesia practice have an effect on HPV (2). No commonly used drugs augment HPV but many drugs inhibit HPV in a dose dependent manner. Halotane has been well studied and is considered a potent inhibitor of HPV.(2) Isoflurane has the same effect and does not seem to be any difference between the modern anesthetic volatile agents Sevoflurane and desflurane.(2,3,4,5) On the other side intravenous agents show no inhibition of HPV: propofol causes some systemic vasodilation but it does not inhibit HPV.(6)

On the basis of these considerations it should be considered that during laparoscopic surgery a V/Q mismatch is created so the role of HPV becomes very important.(3,4,5,7,8) TIVA/TCI technique maintaining HPV guarantees a better PaO₂ during surgery: our study confirms this hypothesis; have to be considered also the reduction of PaCO₂ in the IG and the inspiratory peak level increase in the GG

Conclusion: On the basis of this report we have to considerer TIVA/TCI anesthetic technique of choice during laparoscopic prostatectomy.

Bibliography:

1. Lumb AB, Slinger MD: Hypoxic pulmonary vasocstriction. *Anesthesiology* 2015;122:932-946
2. Marshall C, Lindgren L, Marshall BE: Effects of halothane, enflurane, and isoflurane on hypoxic pulmonary vasoconstriction in rat lungs in vitro. *Anesthesiology* 1984; 60:304–8
3. Benumof JL, Augustine SD, Gibbons JA: Halothane and isoflurane only slightly impair arterial oxygenation during one-lung ventilation in patients undergoing thoracotomy. *Anesthesiology* 1987; 67:910–5
4. Wang JY, Russell GN, Page RD, Jackson M, Pennefather SH: Comparison of the effects of sevoflurane and isoflurane on arterial oxygenation during one lung ventilation. *Br J Anaesth* 1998; 81:850–3
5. Pagel PS, Fu JL, Damask MC, Davis RF, Samuelson PN, Howie MB, Warltier DC: Desflurane and isoflurane produce similar alterations in systemic and pulmonary hemodynamics and arterial oxygenation in patients undergoing one-lung ventilation during thoracotomy. *Anesth Analg* 1998; 87:800–7
6. Van Keer L, Van Aken H, Vandermeersch E, Vermaut G, Lerut T: Propofol does not inhibit hypoxic pulmonary vasoconstriction in humans. *J Clin Anesth* 1989; 1:284–8
7. Reid C, Slinger P, Lenis S: A comparison of the effects of propofol-alfentanil versus isoflurane anesthesia during one lung ventilation. *J Cardiothorac Vasc Anesth* 1996; 10:860–3
8. Pruszkowski O, Dalibon N, Moutafis M, Jugan E, Law-Koune JD, Laloë PA, Fischler M: Effects of propofol vs sevoflurane on arterial oxygenation during one-lung ventilation. *Br J Anaesth* 2007; 98:539–44
9. Schulte-Sasse U, Hess W, Tarnow J: Pulmonary vascular responses to nitrous oxide in patients with normal and high pulmonary vascular resistance. *Anesthesiology* 1982; 57:9–13

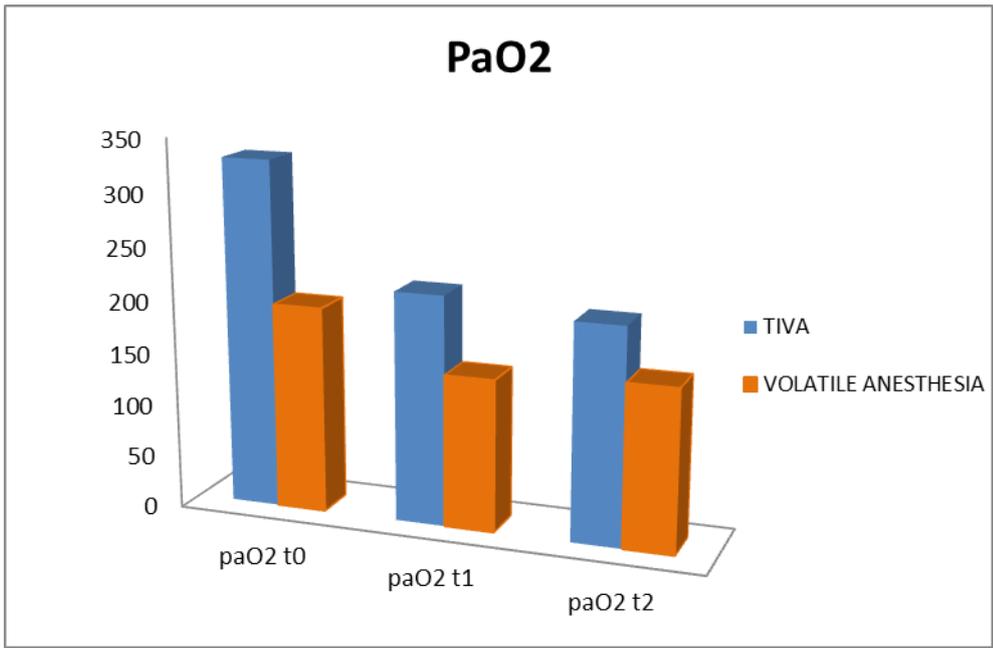


Fig.1

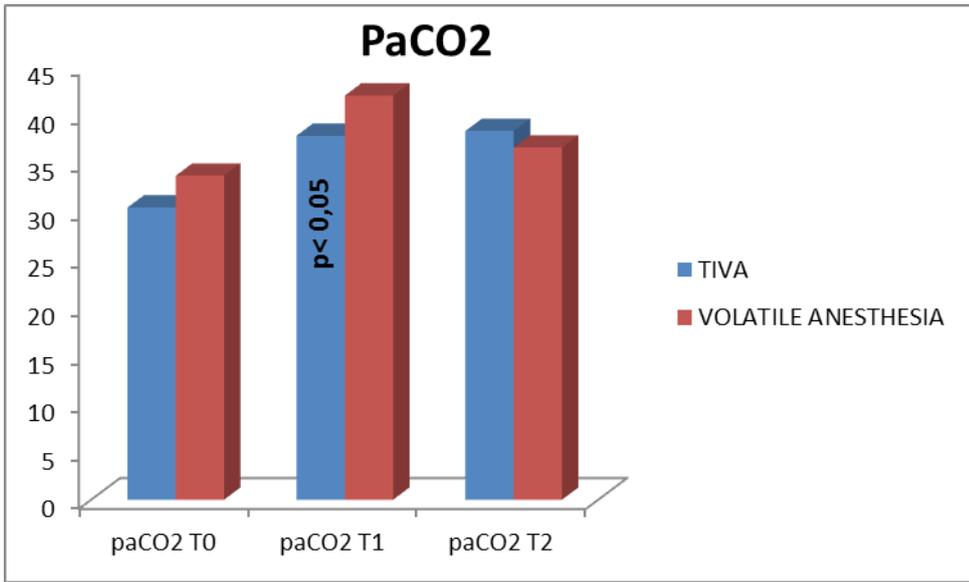


Fig.2

Pressione picco aw

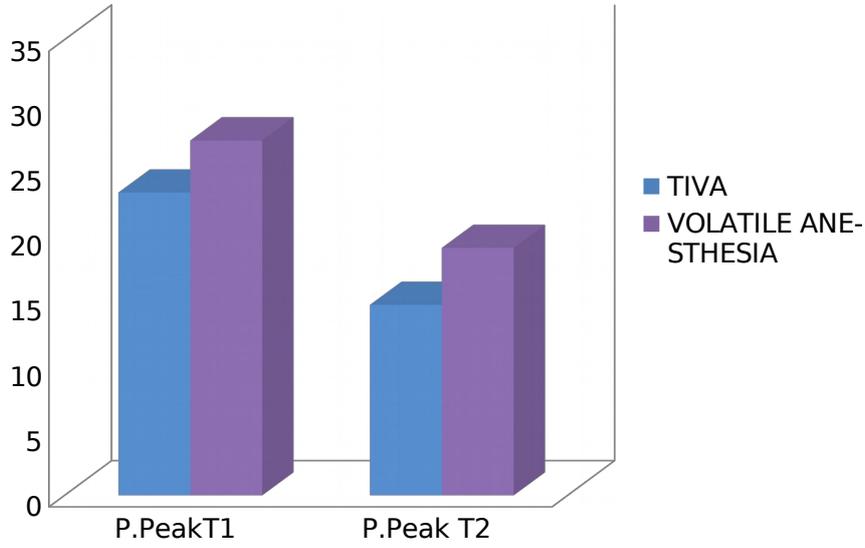


Fig.3

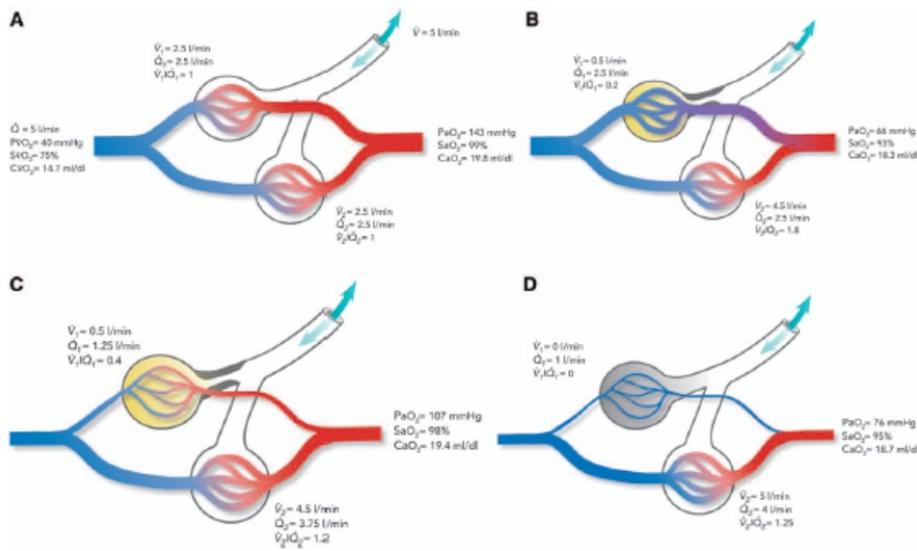


Fig.4