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Intraperitoneal drug nebulization during laparoscopic surgery.

The intra-operative hypothermia observed during prolonged laparoscopic surgery and the potential benefits of humidified CO₂ during insufflation have promoted the availability for several commercial gas humidifying devices. The technology of these devices is based either on evaporation or on nebulization-, and some heat the insufflating gas as well. These humidification devices could also be used to administer drugs intraperitoneally, by replacing water with a drug solution as the humidification liquid.

Intraperitoneal administration of local anesthetics improves perioperative analgesia during laparoscopic and has a significant post-operative opioid sparing effect as well as a reduction in post-operative nausea and vomiting (PONV). Simultaneous humidification of insufflating gas and intraperitoneal local anesthetic administration, could therefore altogether prevent intra-operative hypothermia and provide perioperative analgesia.

Intraperitoneal aerosolization has been shown to be efficient in spreading drugs homogeneously, but potential deterioration in the surgeon's vision due to fog remains a problem. Devices using evaporation to humidify insufflating gas do not efficiently deliver drugs. These results are in keeping with the physical principle that evaporation enables only evaporation of the solvent (here water) and not of the solute (the drug). Thus, although these devices are efficient in humidification, they are inappropriate for delivering local anesthetics.

The Aeroneb* device is a high frequency vibrating membrane nebulizer, allowing simultaneous humidification and delivery of drugs. It seems to be important to place this humidification device as close to the patient as possible in order to avoid condensation and/or deposition of drug droplets on the insufflation silicone tubing wall. However, it is not possible to place the Aeroneb* device in the surgical field during the procedure because, although the humidifier itself is sterilizable, its power cable is not.

The Aeroneb* humidifier humidifies the inflating gas by cold nebulization, is reusable, easy to assemble, and has been used for inhalation therapy in pediatric patients. It does not need any specific driving gas to be effective.

Deterioration in the surgeon's vision due to fog has been described with intraperitoneal aerosolization techniques, thus the potential blurring of the surgeons vision by Aeroneb* nebulization needs to be assessed in clinical studies.

The precise knowledge of the amount of drug inserted in the Aeroneb device avoids any risk of systemic toxicity due to overdosage. In prolonged cases, all of the drug solution may be nebulized before the end of the procedure. In order to maintain the humidification function, the reservoir of the device can subsequently be filled with normal saline. Other humidification devices based either on heated evaporation (HC550* Fisher & Paykel, Auckland, New Zealand) or on semi-permeable membrane

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evaporation (HME-Booster* Medisize, Hillegom, Netherlands), have been used for humidification and warming of insufflated airway gases. However, similar to the other evaporation devices (e.g.: Airlife*, Humidifier 20432033, and Laparoshield*), it seems improbable that these devices would be able to transport drugs dissolved in water. The other concerns with heating devices are a potential risk of bacterial colonization, and the molecular shaking that occurs during the solution's heating, which may cause denaturation of the active compounds.

Importantly, to be useful in the laparoscopic surgery setting, a humidification device should also operate without any interference with the CO₂ inflow and pressure regulation by the insufflator. The Aeroneb* features these characteristics.

The experimental data about nebulization look promising but should be confirmed in a clinical setting.

In conclusion, the microvibration-based nebulizer Aeroneb* may be used to deliver local anesthetics along with CO₂ insufflation during laparoscopy. Further research is needed to confirm into clinical practice, if this nebulizer may allow both hypothermia prevention and reduction of postoperative pain/PONV, without blurring the surgeon's vision.