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Airway management using ultrasound☆

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ABSTRACT

Ultrasonography as a diagnostic and therapeutic tool has greatly impacted the anesthesiologist's routine in multiple practical applications. However, only recently there have been some reports published in the literature on the use of ultrasonography for the management of the airway in the surgical and ICU patients. Being a portable, easy to use, non-invasive tool that does not require any ionizing energy, ultrasonography becomes highly attractive when the anesthesiologist faces practical issues in a difficult airway. The purpose of this review was precisely to show the potential uses of ultrasonography for difficult airway management, from the literature perspective.

There is enough trials-based evidence so far to recommend the use of ultrasonography for the following situations: identification of anatomical airway structures, static detection of a failed or esophageal intubation, dynamic airway measurements, and size determination of endotracheal tubes; identification of predictors of a difficult airway in patients with challenging necks, and trans-tracheal techniques to secure the airway.

Nevertheless, further studies with strong methodological quality are required to show the potential of ultrasonography to impact the difficult airway management and the morbidity and mortality associated with this condition.

El uso del ultrasonido en el manejo de la vía aérea

Palabras clave:
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RESUMEN

La ecografía como herramienta diagnóstica y terapéutica ha tenido un gran impacto en el quehacer rutinario del anestesiólogo en múltiples áreas de aplicación práctica. Sin embargo, es hasta hace poco en donde han aparecido en la literatura reportes de su uso en situaciones que involucra el manejo de la vía área del paciente en cirugía y unidades de cuidados intensivos. Al ser esta una herramienta portable, fácil de usar, no invasiva y sin necesidad de

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energía ionizante, la hace altamente atractiva al momento de resolver preguntas prácticas del anestesiólogo que se ve enfrentado a una vía área difícil. Justamente el objetivo de esta revisión fue mostrar desde la literatura cuales son los potenciales usos de los ecografía en el manejo de la vía área.

Hasta el momento los estudios muestran suficientes elementos para recomendar su uso en los siguientes situaciones: identificación de estructuras anatómicas en la vía área; detección estática de intubación fallida o esofágica; mediciones dinámicas de la vía área y determinación del tamaño de tubos endotraqueales; predictores de vía área difícil en pacientes con cuello desfavorable; y técnicas transtraqueales para aseguramiento de la vía área.

A pesar de ello, aún se requieren mayores estudios con suficiente calidad metodológica en donde se demuestre que el uso de la ecografía si puede llegar a impactar en el manejo de la vía área difícil y en la morbimortalidad generada por esta entidad.

Introduction

Airway management is one of the critical skills of the anesthesiologist. Close to 64% of the anesthesia-associated deaths are the result of airway management complications, both during induction and securing of the airway.[1] Ultrasound is a portable, easy to use, noninvasive tool with high sensitivity rates than can be used in combination with other devises for proper perioperative airway management.[2–4]

This review discusses the role of ultrasound as an additional complementary tool in the management of the airway in different situations, including the identification of structures, detection of esophageal intubation, positioning of the endotracheal tube, proper size selection of the conventional and double-lumen endotracheal tube, determination of adequate face mask or supraglottic device ventilation, difficult airway predictors, predictors of risk of postextubation stridor, and ultrasound-guided translaryngeal techniques, including translaryngeal blocks, retrograde intubation and percutaneous tracheostomy.

Preparation

Adequate evaluation and ultrasound visualization of the airway requires the patient to be in a centered sniffing position.[5] Since the structures to be visualized are superficial, most of the airway windows may be obtained using a 7.5-Mhz high-frequency lineal transducer. Remember to use a proper hydrosoluble gel for image optimization, eliminating the air interface, adjusting the equipment settings for superficial soft tissues, adjusting the depth to 3–4 cm and the focus 1 cm posterior to the structure to be visualized. If the target for visualization is the hyoid bone, an enhanced visualization may be achieved using the 5-Mhz convex transducer.

Ultrasound identification of airway structures

Air prevents the passage of ultrasound waves, generating hyper or hypo-echoic reverberation artifacts that hinder the visualization of deep structures but allows for easy identification of the airway since it is the only structure that produces comet tails, reverberations and acoustic shadowing.

The bone presents as a hyperechoic structure that produces an anechoic shadow; the main bone structure in the airway is the hyoid bone, but in over fifty percent of the patients it cannot be fully visualized.[6]

The tracheal cartilages are hyperechoic, as well as the cricothyroid membrane and the vocal cords.[6]

Furthermore, it is important to keep in mind that the mucosa/air interface looks hyperechoic, as for instance the interface below the cricothyroid membrane.

There are two ultrasonography approaches for the airway: the axial or short axis and the longitudinal or long axis (Fig. 1).

Hyoid bone

The identification of the hyoid bone may be from a transverse or longitudinal approach; it is a hyperechoic structure with a hypoechoic U-shape halo (Fig. 2); although there is no standard technique, successful cases have been reported of ultrasound-guided superior laryngeal nerve block at the horn of the hyoid bone.[7]

Epiglottis

The epiglottis cross-section may be visualized with the high-frequency lineal transducer at the thyroid–hyoid space. It is characterized by a hypoechoic U-shape image preceded at its anterior margin by the pre-epiglottic space that is hyperechoic and relates posteriorly with the hyperechoic interface between the mucosa and the air[7] (Fig. 3).

Thyroid cartilage

Is one of the best visualized structures described at the transverse axis as a hypoechoic structure with respect to the vocal cords, followed by an acoustic shadow corresponding to the airway (Fig. 4); on the sagittal plane, the thyroid–hyoid space and the acoustic shadow in the hyoid bone can be evaluated (Fig. 2).[7,8] At this level, the vocal cords can be seen as hypoechoic structures. Pathological conditions such as the unilateral paralysis of the vocal cords may be identified at this level, when the patient is asked to emit a sound to see the vibration of the vocal cords – adduction and abduction of the vocal cords (Fig. 4).