A systematic approach to evaluate age related changes of the pediatric airway with ultrasound

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BACKGROUND

Evaluation of the upper airway in children is commonly performed by direct visualization under general anesthesia or with advanced radiologic imaging studies, such as CT, which has the added risk of radiation exposure.1 The anatomy of the airway in a child is continually changing with age, causing the anesthesiologist to provide or modify their approach to the management of the airway.

Ultrasonography is a portable, non-invasive tool that may be used to evaluate the upper airway without exposing the patient to radiation. Sonographic evaluation of the pediatric airway is critical to safe, effective, and efficient management of routine and rare conditions involving the oropharynx, hypopharynx, and trachea.1 It has become readily available in pediatric surgical locations and anesthesiologists are often already well skilled in its use to evaluate vascular structures within the neck. The utility of ultrasound as an adjunct to clinical methods of bedside airway assessment has been described.2-5 It has also been used to describe specific pediatric airway pathology.2,6

Small, linear high-frequency probes are ideal for children, as they allow for easier manipulation within the tight confines of the necks of short patients. Also the shallow depth of the upper airway obviates the need to use larger, low-frequency probes. A systematic approach to identify and describe the salient features of the pediatric airway and the changes that subsequently occur with normal growth and development in children are described.

OBJECTIVE

1. Provide a systematic approach using 5 transducer positions
2. Describe the feasibility of ultrasound evaluation in the pediatric airway
3. To characterize the salient features of the pediatric airway at specific eternal locations the ultrasound transducer is placed
4. Describe the upper airway anatomy and changes that occur with growth

METHODS

• The study evaluated 43 total ASA 1 & 2 pediatric patients from 1 day to 10 years of age
• The SonoSite M-Turbo Ultrasound Machine with the 25mm broadband linear array transducer (L25x 13-6 MHz) probe with a 6cm scanning depth was used to obtain images
• Five standardized ultrasound views were obtained in all patients:
  • axial view at the level of the cricoid membrane (AC)
  • axial view at the level of the vocal cords (AVC)
  • longitudinal view of trachea (LT)
  • sternal notch level view of the trachea (SNT)
  • submental space view (SM)
• Images were obtained in the OR following mask induction, while the patient was spontaneously breathing and prior to any airway manipulation
• Java-based ImageJ processing (National Institute of Health) was used for measurement analysis

RESULTS

• A systematic approach to ultrasound imaging of the pediatric airway in spontaneously breathing patients can be performed using 5 positions
• Anatomic structures of the pediatric airway are recognizable with ultrasound
• Subtle changes in airway dimensions with age may be measured with ultrasound
  • In young infants the Axial Views of the cricoid and vocal cords are easily obtained and anatomic enlargement with age could easily be appreciated
  • The Submental Space View could easily be obtained in all ages and enlargement with age was appreciated
• The evolving changes in the pediatric patient with age provides some limitation
  • Measuring the tracheal diameter in infants (Longitudinal Tracheal View and Sternal Notch View) could be easily assessed; however in older children, the acoustic shadows from tracheal ring ossification obscures the ability to consistently measure the tracheal diameter

CONCLUSION

A systematic approach to ultrasound imaging of the pediatric airway in spontaneously breathing patients can be performed using 5 positions

REFERENCES