

The paper was presented at the Second International Symposium on pediatric airway, Podgorica (May, 2014).

ROLE OF VIDEO-ASSISTED TECHNIQUES FOR AIRWAY MANAGEMENT IN PEDIATRIC PATIENT

Massimiliano Sorbello¹, Salvatore Nicosia,¹
Marijana Karisik², Dusanka Janjevic³

¹ Anesthesia and Intensive Care, AOU Policlinico Vittorio Emanuele, Catania, Italy

² Department of Pediatric Anesthesia, Institute for Children Diseases, Podgorica, Montenegro

³ Department of Ear, Nose and Throat, Clinical Center of Vojvodina, Novi Sad, Serbia

Rad je saopšten na Drugom internacionalnom simpozijumu o pedijatrijskom disajnom putu, Podgorica (maj, 2014. god.)

ULOGA VIDEO-ASISTIRANIH TEHNIKA U OBEZBEĐIVANJU DISAJNOG PUTA KOD PEDIJATRIJSKIH PACIJENATA

Massimiliano Sorbello¹, Salvatore Nicosia,¹
Marijana Karišik², Dusanka Janjevič³

¹ Odeljenje anesteziologije i intenzivne terapije, Poliklinika Vittorio Emanuel, Katania, Italija

² Odeljenje anestezije, Institut za bolesti dece, Podgorica

³ Odeljenje za uho, grlo i nos, Klinički centar Vojvodine, Novi Sad

Summary. This paper presents the types of video laryngoscopy, used in the pediatric population and their role in securing the airway in children. The benefits of video-laryngoscopy are outlined, which are generally associated with better visualization of the glottis. On the other hand, video laryngoscopy lasts longer, especially if done by inexperienced anaesthesiologists, and does not provide protection from desaturation or other complications in high-risk patients and problematic airway. In the literature there is still not enough evidence regarding the question whether advantages or disadvantages of video laryngoscopy prevail over conventional laryngoscopy in the management of the airway in children.

Key words: pediatric patients, airway management, video-laryngoscopy

Sažetak. U radu su prikazane vrste video-laringoskopa koji se koriste u pedijatrijskoj populaciji i njihova uloga u obezbeđivanju disajnog puta kod dece. Ukazano je na prednosti video-laringoskopije koje su, uglavnom povezane sa boljom vizuelizacijom glotisa. Sa druge strane, videolaringoskopija duže traje, osobito kod nedovoljno iskusnih anesteziologa, i ne pruža zaštitu od desaturacije ili drugih komplikacija kod rizičnih pacijenata i problematičnog disajnog puta. Još uvek nema dovoljno dokaza u literaturi da li preovlađuju prednosti ili nedostaci videolaringoskopije nad konvencionalnom laringoskopijom u zbrinjavanju disajnog puta kod dece.

Ključne reči: pedijatrijski pacijenti, obezbeđenje disajnog puta, video-laringoskopija

Introduction

Airway management in pediatric patients is a specific skill which gives perfect example of experience related difficulties. Laryngoscopy per se is rare to be difficult in pediatric patients, with a low incidence of 1.35% in children if compared to 5.8% in adults^{1,2}.

Nevertheless, in case of poor experience, even not really difficult cases might become extremely challenging, for many reasons.

Airway characteristics are different in children (especially if less than one year of age: large occiputs, larger tongue, floppy omega shaped epiglottis and cranially located larynges are main anatomical differences); functional residual capacity (FRC) and oxygen consumption are respectively lower and higher if compared to adults, thus resulting in faster desaturation because of lower reserve³.

Real difficulties are rare and they usually correspond to important macroscopic findings which can't be undiagnosed or unpredicted. When a real

difficulty is encountered in pediatric patients, it is normally a severe difficulty with contemporary high risk for ventilation, that is why special techniques (spontaneous breathing, volatile induction and limited use of neuromuscular blocking agents) and devices (LMA, fiberoptic bronchoscope and combined “dedicated airway” use) are commonly first and safest choice.

Starting from this point of view, we can now ask if there is a role for videolaryngoscopes in pediatric population.

Technical advances in laryngoscopy

Continuous technical evolution in the field of Medicine is reflected also in the field of Anesthesia, and videolaryngoscopes are result of natural evolution of concept of laryngoscopy during the last seventy years.

Different conventional, or “direct” laryngoscopes have been developed since introduction of MacIntosh laryngoscopes, with special features for pediatric or neonatal patients, such as Miller blade. Whichever the blade, anyway, idea is always to obtain a straight line of sight between the physician’s eye and the larynx, by positioning correctly the patients and lifting and levering oropharyngeal structures so to obtain direct laryngeal visualization.

In practical terms, obtaining this alignment is technically easier in pediatric patients if compared to adults, even because many of the reasons which could limit “line of sight” (such as macroglossia, reduced mouth opening, reduced neck motility, scars, burns, and other comorbidities related to difficult laryngoscopy) are more rare or difficult to observe in newborns or pediatric population. There is actually evidence that most of referred difficulties in pediatric population could be considered as “pseudo-difficulties” more related to low skill with management of pediatric patients rather with difficult laryngoscopy per se³.

Do we really need video-laryngoscopy?

If we look at numbers, we might admit that conventional laryngoscopy is successful and effective in around 98,5%, so performance of any competitor should be compared with this result and keeping in mind the real cost/benefit ratio, with a theoretical little or no advantage in low risk patients⁴.

What is then, or which could be, real advantage of use of videolaryngoscopes in pediatric population? Part of the answer probably lies in different concept underlying videolaryngoscopy. It has also been referred as “indirect” laryngoscopy because view of airway structures is not any more related to obtaining line of sight, while being result of airway structures visualization on external or build-in screens thanks to images obtained via optical or electronic systems.

This way, any difficulty to straighten oropharyngeal and laryngeal axis is overcome by moving observer’s eye close to the larynx, with final result that, as a general rule, difficult laryngoscopy is extremely rare with use of videolaryngoscopes.

On other hand, there are many prices to pay for such a result: videolaryngoscopes, especially the so called “channeled”, are bulkier than conventional laryngoscopic blades, they can have some potentially harmful “blind spots” and they move concept of difficulty from laryngoscopy to intubation. Especially if using unchanneled devices, real difficulty remains negotiating addressing and passage of endotracheal tube through vocal cords, with result that some studies underline that time to intubate is longer with videolaryngoscopes if compared to classic laryngoscope and occurrence of desaturation is higher, especially in critical patients⁵ (concept which we could extend also to physiologically limited FRC patients such as pediatric population)³.

Other not less important point is development of dedicated skill for use of videolaryngoscopes: if compared to classic laryngoscopy, there is a further intermediate point in coordination between eye and hand during intubation manoeuvres, which is external screen. This might result in longer time to intubate, initial difficulty or incoordination and fail to produce fine tuning manoeuvres during laryngoscopy as when direct view is obtained, because observing on external screen.

For all these reasons, use of videolaryngoscopes and expected demonstration of superiority versus conventional laryngoscopy still remains topic of debate and leaves many questions unanswered⁵.

Specific considerations in pediatric population

On other hand, there are specific considerations to be made with pediatric population.

Not all centres or hospital can have privilege of a dedicated group for pediatric anesthesia (which should be anyway goal of any health institution), so any device which allows a second opportunity and which could theoretically minimize weight of low-experience bias can be extremely useful, especially if its use remains effective in terms of low complication rate.

We already affirmed that a pediatric difficult intubation is usually predictable as it is associated with important anatomical abnormalities, not rarely due to inherited causes or congenital syndromes. In this cases, use of flexible fiberoptic bronchoscopy (more or less combined with dedicated airway such an extraglottic device allowing passage of bronchoscope) remains the standard of care, whereas it requires specific training and skill, which are probably even more challenging to perform in pediatric difficult airways.

Developement of such a skill is long and difficult, even taking account of incidence of really difficult cases in pediatric population and of difficulty to simulate these scenarios in any training program. So, also in this case, potential role of videolaryngoscopes could be an intermediate skill step, easier than fiberoptic and different than conventional laryngoscopy, to grant a further attempt while maintaining adequate standards of safety.

Last but not least, we should never forget that no videolaryngoscope can provide adequate ventilation or oxygenation; so, whenever expected or unexpected difficulty means oxygenation impairment, no one of these devices, or fiberoptic, could be the solution, but fast and early use of alternative ventilation strategies, first of wich remains use of extraglottic devices.

Finally, issues of costs, which for any available device are still much higher than classic laryngoscopy, should always be balanced on number of anesthetics performed, number of critical cases and presence of effective, low risk and lower cost alternatives (LMA, but MacIntosh as first consideration).

Types of video laryngoscopes for pediatric patients

If looking at the Market, There are four videolaryngoscopes with blades available for use in neonates and children:

- Glidescope (Verathon Medical Inc., Bothell, WA, USA)
- Truview (Truphatek, Netanya, Israel)
- Storz (Karl Storz, Tuttlingen, Germany)
- Airtraq™ (Prodol, Vizcaya, Spain)

First three devices are unchanneled devices often requiring use of styletted tube to perform intubation. Common theoretical advantages are familiarity with approach in laryngoscopy (closer to classical one), less bulky devices with more room for tube manoeuvring and generally higher optical definition due to electronic video system rather than lenses (except for Truview).

Truview has a patented design blade with straight course and curved tip and is based on optical system, with both eyepiece and option for external camera and screen connections. Glidescope comes in both reusable and single use blade versions, and offers a wide external screen and a viewing system based on digital camera. Storz system offers both normal and difficult airways blades with external screen and digital camera.

Airtraq is the only one channelled, thus not requiring styletted tube, with different models also for nasotracheal intubation; it is based on optical viewing system with external eyepiece or option for supplementary camera and screen. Presence of tube channel on one hand results in no need for stylet, possibility to use introducer and theoretical lower risk of perfect view-intubation difficulty combination; on other hand, price to pay is larger dimensions for blade with result of bulkier device requiring more room in oral cavity and superior mouth opening if compared to MacIntosh or other videolaryngoscopes.

The advantages of video laryngoscopy in children: is there evidence?

There is poor literature contribution on use of videolaryngoscopy in children, much less than in adults, and majority of published papers are case reports, case series or studies on manikins. Only few papers compared videolaryngoscopy with con-

ventional laryngoscopy as randomized controlled studies, finding similar results that for adult patients, which can be summarized in better laryngeal view, effective intubation and longer time for manoeuvring for videolaryngoscopes.

A retrospective case series for airway management in 41 general anesthetics for mucopolysaccharidosis pediatric patients using Airtraq⁶ showed rescue role for this device in one case after failed conventional laryngoscopy; a prospective study on 18 children with known difficult airways⁷, showed that Glidescope resulted in a better view and higher success of intubation when compared to conventional direct laryngoscopy. Other studies have been published to assess performance of Airtraq^{8,9}, or Storz system¹⁰, Glidescope Cobalt¹¹ or Airtraq¹² versus MacIntosh, with promising results, or to compare videolaryngoscopes in pediatric patients populations¹³.

A very recent paper by Ali et Al, describing use of pediatric Airtraq, results not only in high performance for this device but also to show shorter time for intubation and lack of complications if compared to Macintosh¹⁴, taking account that all airtraq users were skilled in use of device in both adult and pediatric population.

In any case, just as for adult patients studies, main point to be reviewed is choice of suitable scoring system to assess laryngeal view when comparing videolaryngoscopes and conventional ones, because standard approach with classical Cormack and Lehane grading is somehow unfair, and overfavours indirect laryngoscopes performance¹⁵. Other point to be cleared, and specifically for clinical implications in pediatric patients, is if videolaryngoscopy results in longer time if compared with laryngoscopy, if this has clinical meaning in pediatric population and if it is worth the effort to pay this due if thinking of routine clinical use.

If we have to imagine future development and result, probably also experience in pediatric population will result in excellent performance for videolaryngoscopes during laryngoscopy in pediatric population, thanks to different conceptual approach with no need for line of sight.

Main questions which remain unanswered, and which deserve high quality studies to recognize value of this devices, are whether shape of blade can affect performance (Ali et al¹⁴, for example, observe that exaggerated and anatomical curvature

of Airtraq blade successfully contributes to provide advantages in glottic exposure even in pediatric patients with anterior positioned glottis), if device dimensions can be use-limiting and if different approaches with channeled or unchanneled devices offer some advantage or may affect incidence of eventual complications.

Conclusion

Universal adoptance of appropriate laryngoscopic difficulty grading will allow to assess real advantage over MacIntosh and will provide homogeneous data to understand if time to manoeuvre is longer with videolaryngoscopes, how much it might depend on skill and, not less important, if this might affect morbidity of intubation.

Considering that MacIntosh approach, despite its age, remains the most common, cheap and actually effective approach to routine airway management in pediatric population, task for videolaryngoscopes is challenging, probably much more than in adult population, where real advantage of these devices is clearer. Until that day, what is really important is to develop and maintain adequate skills for airway management in pediatric patients, taking account that main cause of difficulty remains poor experience, and call for videolaryngoscopes in pediatric population, while seeming natural result of evolution and technology, could only remain a "cosmetic" solution and not really effective approach for the problem.

References

1. Heinrich S, Birkholz T, Ihmsen H, Irouschek A, Ackermann A, Schmidt J. Incidence and predictors of difficult laryngoscopy in 11,219 pediatric anesthesia procedures. *Pediatric Anesthesia* 2012; 22:729-36
2. Shiga T, Wajam Z, Inoue T, Sakimoto A. Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance. *Anaesthesiology* 2005;103:429-37
3. Frova G, Guarino A, Petrini F, Merli G, Sorbello M. Recommendations for airway control and difficult airway management in paediatric patients. *Minerva Anestesiologica* 2006 Sep;72(9):723-48
4. Mathew PJ. Videolaryngoscopy - Is there a role in paediatric airway management? *Minerva Anestesiologica* 2013;79:1326-28
5. Merli G, Guarino A, Petrini F, Sorbello M, Frova G. Should we really consider to lay down the Macintosh

laryngoscope? *Minerva Anesthesiol.* 2012 Sep;78(9):1078-9

6. Osthaus WA, Harendza T, Witt LH, Jüttner B, Dieck T, Grigull L et al. Paediatric airway management in mucopolysaccharidosis 1: a retrospective case review. *Eur J Anaesthesiol* 2012;29:204-7

7. Armstrong J, John J, Karsli C. A comparison between the GlideScope Video Laryngoscope and direct laryngoscope in paediatric patients with difficult airways - a pilot study. *Anaesthesia* 2010;65:353-7

8. Shimada N, Hirabayashi Y, Taga N, Takeuchi M, Seo N. Airtraq optical laryngoscope: clinical assessment of its performance in 100 children. *Masui* 2011;60:168-72

9. Hirabayashi Y, Shimada N. Airtraq® optical laryngoscope: initial clinical experience in 20 children. *J Anesth* 2010;24:148-9

10. Macnair D, Baraclough D, Wilson G, Bloch M, Engelhardt T. Pediatric airway management: comparing the Berci-Kaplan videolaryngoscope with direct laryngoscopy. *Pediatric Anesthesia* 2009;19:577-80

11. Fiadjoe JE, Gurmaney H, Dalesio N, Sussman E, Zhao H, Zhang X, Stricker PA. A prospective randomized equivalence trial of the Glidescope cobaltR Videolaryngoscope to traditional direct laryngoscopy in neonates and infants. *Anesthesiology* 2012;116:622-8

12. White MC, Marsh CJ, Beringer RM, Nolan JA, Choi AY, Medlock KE et al. A randomised, controlled trial comparing the Airtraq® TM optical laryngoscope with conventional laryngoscopy in infants and children. *Anesthesia* 2012;67:226-31

13. Sorensen MK, Holm-Knidsen R. Endotracheal intubation with airtraq versus storz videolaryngoscope in children younger than two years - a randomized pilot-study. *BMC Anesthesiology* 2012;12:7-11

14. Ali QE, Amir SH, Firdaus U, Siddiqui OA, Azhar AZ. A comparative study of the efficacy of Pediatric Airtraq® with conventional laryngoscope in children. *Minerva Anesthesiol* 2013;79:1366-70

15. Swann AD, English JD, O'Loughlin EJ. The development and preliminary evaluation of a proposed new scoring system for videolaryngoscopy. *Anaesth Intensive Care* 2012;40:697-701