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A Consecutive Case Series of Rescue Intubations With the Articulating Total Control Introducer for Precision Tracheal Access

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Effective rescue after failed intubation is important to limit the number of attempts and patient risk. Nothing is known about the Total Control Introducer's (TCI) effectiveness as an intubation rescue device. A single system's airway management database was studied. The TCI was used for rescue in 34 cases. Overall success was 33 of 34 (97%). First-pass success was 32 of 33 (97%). First-pass rescue was successful in 12 of 12 (100%) after video and direct laryngoscopy had failed. In this case series, the TCI was found to be a highly effective rescue technique after failed direct and video laryngoscopy. (A&A Practice. 2021;15:e01418.)

GLOSSARY

DL = direct laryngoscopy; **EMR** = electronic medical record; **FOB** = fiberoptic bronchoscope; **iSGA** = intubating supraglottic airway; **TCI** = Total Control Introducer; **VL** = video laryngoscopy

Direct laryngoscopy (DL) and video laryngoscopy (VL) are commonly used for tracheal intubation. Each can fail. Multiple intubation attempts correlate with increased morbidity and mortality.[1,2] The ability to predict difficult intubations is poor,[3] making readily available and effective rescue devices and techniques lifesaving.

Unless a blind technique is used (such as an intubating supraglottic airway [iSGA], lighted stylet, or blind nasal intubation), successful rescue intubation involves 2 steps: (1) glottic visualization and (2) accessing the trachea. Intubations with DL or VL may be difficult for different reasons. In the case of DL, most difficult intubations are due to anatomy that makes direct glottic visualization difficult or impossible.[4] If a portion of the glottis can be seen directly with DL, then tracheal access can generally be achieved along that same direct line of sight. VL can improve glottic visualization compared to DL by allowing providers to indirectly visualize the glottis around the naturally occurring oropharyngeal curve of the upper airway without the need to flatten that curve. While adequate visualization of the glottis may be achieved with VL, an intact curve in the upper airway can make navigation into the trachea difficult or even impossible.[5] Failure to navigate into the trachea accounts for up to half of intubation failures with VL.[3]

VL was introduced into practice almost 2 decades ago, intent on solving the visualization problem associated with DL. There has been little advancement in tracheal access technology. Few introducers have been specifically designed to dynamically navigate the serpentine pathway associated with VL.[6,7] None have achieved widespread use. Widely available bougies, malleable stylets, and precurved rigid stylets are static and lack dynamic shape control for precise navigation into the trachea. Combined techniques using a fiberoptic bronchoscope (FOB) as a dynamic introducer in combination with VL have been shown to improve intubation success rates in difficult intubations.[8] Cost, and the need for 2 operators for execution, may limit immediate availability and use in rescue situations.[9] The lack of purpose-built dynamic introducers enabling precision tracheal access seems a major gap in intubation technology and may be a real limit to the overall performance of VL.

The Total Control Introducer (TCI; Through The Cords, LLC, Salt Lake City, UT) is an innovative articulating introducer without intrinsic optical capabilities. It has a flexible shaft and controllable tip enabling dynamic navigation and precision tracheal access when used with VL or DL (Figure; Supplemental Digital Content, Video 1, http://links.lww.com/AACR/A423) A modified combined technique using VL in combination with TCI (VL + TCI) takes advantage of VL's visualization capability and the TCI's dynamic and precise navigational capability. This allows difficult visualization of the glottis and/or difficult tracheal access to be solved simultaneously.[7,10]

VIDEO+

Nothing is known about the TCI's performance as an adjunct in the rescue intubations. The aim of this study is to investigate the effectiveness of VL + TCI as a rescue intubation technique. The University of Utah Health Sciences

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Figure. TCI articulating introducer. TCI indicates Total Control Introducer.

Table 1. Successful Rescues After Any Failed Intubation Attempt

Overall number of cases with a TCI rescue attempted	Overall VL + TCI rescue attempt success	First pass VL + TCI rescue attempt success	Second pass VL + TCI rescue attempt success	VL + TCI failure to rescue
34	33/34 (97%)	32/34 (94%)	1 (3%)	1 (3%)

Abbreviations: TCI, Total Control Introducer; VL, video laryngoscopy.

Table 2. Successful Rescue After Various Failed Intubation Attempts Subgroup Analysis

Proceeding failed techniques	Overall VL + TCI rescue attempt success	First pass VL + TCI rescue attempt success	Second pass VL + TCI rescue attempt success	VL + TCI failure to rescue
After failed DL and VL	12/12 (100%)	12	0	0
After failed DL only	7/7 (100%)	7	0	0
After failed VL only	13/14 (93%)	12	1	1/14 (7%)
After failed DL and VL and FOB	1/1 (100%)	1	0	0

Abbreviations: DL, direct laryngoscopy; FOB, fiberoptic bronchoscope; TCI, Total Control Introducer; VL, video laryngoscopy.

Institutional Review Board waived consent for retrospective analysis of cases using only data from the electronic medical record (EMR). Written informed consent for the use of images or videos was obtained where applicable.

STUDY DESIGN

The design of this study is a single system, consecutive case series, EMR review. An airway management database documenting all airways managed by the Department of Anesthesiology at the University of Utah is continuously filled from our EMR. Collected data includes intubation devices used, free text airway procedure notes, case date, and number of attempts. This database was searched for cases in which TCI was used during a rescue attempt after failure to intubate with other airway techniques. A total of 34 cases were identified in which the TCI was used as part of an attempted rescue technique.

This subgroup, "TCI rescue," was then evaluated for these end points:

1. Antecedent failed technique or techniques.
2. Number of successful rescues using a TCI.
3. Number of TCI rescues successful on the first attempt.
4. Number TCI rescues successful after multiple attempts.
5. Number of failed TCI rescues.

RESULTS

A total of 34 cases were identified in which the TCI was used as part of an attempted rescue technique. TCI rescue was successful in 33 of 34 for an overall success rate of 97%. Of these successes, 32 of 33 (97%) were on the first pass and 1 on the second pass (Table 1). In subgroup analysis, TCI rescue was successful in 8 of 8 (100%) of cases when only DL failed, 13 of 14 (93%) of cases when only VL failed, 12 of 12 (100%) of cases when both DL and VL failed, and 1 of 1 (100%) case where DL, VL, and FOB failed (Table 2).

DISCUSSION

Our study found that a modified combined technique using VL + TCI was capable of rescue after failed VL, DL, and in 1 case, after failed FOB. The overall success rate of 97% was similar to those published for other combined techniques.[8,11,12] Importantly, the combination of VL + TCI was able to rescue 100% of failed intubations on the first attempt in cases where both VL and DL failed. This is important, as failure of both VL and DL techniques leaves limited rescue options. These remaining options have drawbacks. They may be expensive, not immediately available, and may require skill sets not regularly put to use.[13] In cases where multiple intubation attempts have failed, it is critical to limit the number of further attempts to mitigate harm.[13,14]

A rescue technique with a perfect success rate, short learning curve, and single-operator execution is ideal.[15] Common rescue techniques include iSGA, flexible FOBs, lighted stylets, optical stylets, and a combined technique (VL + FOB). A recent large, retrospective, and multicentered study demonstrated rescue success rates to be: iSGA (78%), FOB (77%), lighted stylet (77%), and optical stylet (66%).[3] Such high rates of failure are alarming as each additional attempt or failure to secure an airway increases risk of harm.

Combined techniques have demonstrated high first-pass success when used as primary intubation techniques in predicted difficult airways. Little is known about the effectiveness of combined techniques and modified combined techniques such as VL + FOB or VL + TCI in the setting of rescue after failed laryngoscopy.

Lenhardt et al[11] and Mazzinari et al[8] both demonstrated high first-pass success rates when using VL + FOB as primary techniques. Importantly, Mazzinari et al[8] used the FOB simply as a dynamically controllable stylet relying only on VL for visualization. Mazzinari et al[8] found a significantly higher first-pass rate, a significantly lower injury rate, and a significantly lower intubation time with VL + FOB when compared to the standard rigid precurved stylet with VL.[8] This indicates that the value of a FOB, when used with VL, may be its dynamic navigational capabilities, rather than its visualization capabilities.

Evidence of the effectiveness of combined techniques and modified combined techniques in the setting of rescue is limited, but worthy of investigation. Our study demonstrates a high rate of successful rescue on first attempt with a modified combined technique using VL + TCI. During Lenhardt et al's[11] study, 4 patients were successfully rescued with VL + FOB after failed intubation with VL and a rigid precurved stylet. Mazzinari et al[8] noted that VL + FOB was the preferred rescue technique after failure of the primary technique, although the success rate of these rescue attempts was not reported. High rates of success when using VL + FOB as a primary technique and our limited knowledge of the success rates using VL + FOB or VL + TCI as rescue techniques make further investigation intriguing.

This study is a retrospective consecutive case series and has limitations. Factors influencing outcomes such as operator experience, selection bias, and patient characteristics were not controlled. Our findings are limited in nature and may not be generalizable beyond this study. Despite these limitations, this study is helpful in generating hypotheses for further studies of a stronger design to better understand the generalizability of our findings beyond the context of rescue intubations.

The TCI is an innovative articulating introducer aimed at filling the "precision tracheal access" gap. The capability and effectiveness of the TCI in combination with VL found in this study support the need for further investigation to gain a greater understanding of the capabilities and effectiveness of VL + TCI in a wider variety of settings.

CONCLUSIONS

In this study, a modified combined technique, VL + TCI, was used to successfully intubate after failed attempts using DL, VL, and even FOB. Most importantly, VL + TCI was able to rescue 100% of cases where both VL and DL failed. The success rate when using VL + TCI for rescue intubations found in this study is superior to published success rates of FOB, iSGA, lighted stylet, and optical stylets in rescue situations. The success rate of VL + TCI found in this study is similar to published success rates of classic combined techniques utilizing VL + FOB.

DISCLOSURES

Name: Ashka Shah, MD.
Contribution: This author helped with study design, airway database analysis, statistical analysis, and manuscript preparation.
Conflicts of Interest: None.
Name: Katryn Durnford, MS.
Contribution: This author helped with airway database analysis, statistical analysis, and overall project management.
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Name: Lauren Knecht, MD.
Contribution: This author helped with study design, data analysis, statistical analysis, and manuscript preparation.
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Name: Cameron Jacobson, MS.
Contribution: This author helped with EMR warehouse data query and airway database structure.
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Name: Sean Torin Runnels, MD.
Contribution: This author helped design the study, prepare the manuscript, and manage the project.
Conflicts of Interest: S. T. Runnels is the inventor of the TCI and holds shares in Through The Cords LLC.
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