A single-centre case series assessing the Ambu® aScope™ 2 for percutaneous tracheostomies: A viable alternative to fibreoptic bronchoscopes

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BACKGROUND: Bronchoscope-assisted bedside percutaneous tracheostomy is increasingly common in the intensive care unit (ICU). Fiberoptic bronchoscopes (FOBs) are expensive, fragile and may be damaged in the busy ICU environment. The Ambu® aScope™ 2 is a disposable video bronchoscope with no suction port that may be an alternative.
METHODS: The present analysis was a single-centre, prospective, quality improvement series substitution of Ambu® aScope™ 2 for FOB during percutaneous bedside tracheostomy with a FOB readily available. Physicians could elect not to use the Ambu® aScope™ 2.
RESULTS: The Ambu® aScope™ 2 was used in 22 of 30 percutaneous bedside tracheostomies between September 9, 2012 and January 3, 2013. One conversion to an FOB occurred during the 22 procedures due to bleeding, resulting in a convfersion rate of approximately 5%. The rate of completion of the postprocedure questionnaire was 73% (16 of 22), with a mean 'ease of use' score of 8.19/10 (range 6/10 to 10/10) and a mean 'visualization' score of 6.1/10 (range 2/10 to 10/10).
DISCUSSION/CONCLUSIONS: Ambu® aScope™ 2 was a reasonable alternative to FOB in a selected group of patients for bedside ICU PDT. Use of this new disposable scope will depend on local factors, processing delays and cost.

Key Words: *Bronchoscope; Cost effective; Percutaneous tracheostomy*

Une série de cas unicentriques pour évaluer les trachéotomies percutanées par aScope^{MC} 2 d'Ambu^{MD} : une solution de rechange viable aux bronchoscopes à fibre optique

HISTORIQUE : La trachéotomie percutanée assistée par bronchoscopie au chevet du patient est de plus en plus courante à l'unité de soins intensifs (USI). Les bronchofibroscopes (BFS) sont coûteux, fragiles et peuvent être endommagés dans le milieu encombré de l'USI. L'aScope^{MC} 2 d'Ambu^{MD} est un vidéoscope à usage unique sans sonde d'aspiration qui peut remplacer le BFS.
MÉTHODOLOGIE : La présente analyse est une série de cas unicentriques et prospectifs d'amélioration de la qualité remplaçant le BFS par l'aScope^{MC} 2 d'Ambu^{MD} dans le cadre d'une trachéotomie percutanée au chevet du patient, tout en ayant un BFS à portée de la main. Les médecins pouvaient décider de ne pas utiliser l'aScope^{MC} 2 d'Ambu^{MD}.
RÉSULTATS : L'aScope^{MC} 2 d'Ambu^{MD} a été utilisé dans 22 des 30 trachéotomies percutanées au chevet des patients entre le 9 septembre 2012 et le 3 janvier 2013. L'une des 22 interventions s'est associée à un transfert au BFS en raison de saignements, pour un taux de conversion d'environ 5 %. Le taux de complétion du questionnaire après l'intervention s'élevait à 73 % (16 sur 22), pour un score moyen de « facilité d'utilisation » de 8,19 sur 10 (plage de 6 à 10 sur 10) et un score moyen de « visualisation » de 6,1 sur 10 (plage de 2 à 10 sur 10).
EXPOSÉ ET CONCLUSION : L'aScope^{MC} 2 d'Ambu^{MD} était une solution raisonnable pour remplacer le BFS dans un groupe sélectionné de patients pour effectuer une trachéotomie percutanée à l'USI. L'utilisation de ce nouveau vidéoscope à usage unique dépendra de facteurs locaux, des retards de traitement et du coût.

Tracheostomy has been practiced since 2000 BCE to relieve upper airway obstruction (1). It is now one of the most common bedside procedures in a modern intensive care unit (ICU) for facilitating ventilation. The optimal timing of tracheostomy and its benefits are the subject of ongoing debate and research, and helps explain the varied rates of tracheostomy across institutions (2,3). The use of bedside tracheostomy procedures decreases the wait time associated with surgical tracheostomies and may also decrease duration of ventilation (4,5).

Most bedside tracheostomy procedures are performed using percutaneous dilational tracheostomy (PDT). Since PDT was first described in 1985, it has been shown to be a safe, efficient and less expensive alternative to surgical tracheostomy (6,7). Single-step dilation techniques appear to be associated with the lowest complication and failure rates (8). Under endotracheal bronchoscopic visualization, a needle is inserted between second and third tracheal rings. A Seldinger technique is used. The guidewire is fed through the needle and directed caudad into the trachea. Dilation over the guidewire facilitates the ultimate insertion of the tracheostomy tube over an insertion/dilation guide.

The use of bronchoscopy (fibreoptic or camera based) has increased the safety of the original procedure by facilitating landmarking of the insertion site and confirming placement of the tracheostomy (7). This benefit, however, comes at a cost. Several authors have reported fibreoptic bronchoscope (FOB) damage during the procedure (9,10). This is usually due to penetrating needle puncture or blunt crush forces.

In an attempt to mitigate costs associated with bronchoscope repairs while still providing safe, timely PDT to our patients, our institution trialed a single-use flexible intubation scope (Ambu® aScope™ 2, Ambu A/S, Denmark).

METHODS

As part of a quality improvement initiative, a single-centre substitution of the Ambu® aScope™ 2, in the place of the usual FOB, during PDT was performed. The patients selected were medically stable, with minimal to moderate secretions. A standard FOB, prepared at the bedside, was available should substitution be required. The physicians performing the procedure evaluated the adequacy of the Ambu® aScope™2 for this procedure using a series of subjective questions about visualization and ease of use. All physicians performing PDT were experienced operators

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TABLE 1
Test results

Conversion to regular fibreoptic bronchoscopy	1/22 (4.5)
Adequate for procedure	20/22 (91)
Ease of use (1–10)	
Rate of response	16/22 (73)
Mean ± SD	8.19±1.51
Visualization (1–10)	
Rate of response	15/22 (68)
Mean ± SD	6.1±2.53

Data presented as n/n (%) unless otherwise indicated. 'Ease of use' and 'visualization' were assessed on a 10-point Likert scale, with 10 being perfect and 1 being inadequate for the procedure

TABLE 2
Comments from low visualization scores

Visualization score	Comments
3	Light source not sufficient for transillumination to place tracheostomy. Visualization would be improved with a brighter light source and addition of suction capability.
3	Needed to convert to regular bronchoscopy due to bleeding and lack of suctioning
2	I'm very concerned re: visualization + safety… Ok generally as procedure can be done without scope and most always no complication. However, if there was a complication having to change scopes would be hard to defend as delay would be significant.

with >50 procedures performed each using fibreoptic bronchoscopy before the present equipment trial. PDT bedside procedures were performed using the Ciaglia Blue Rhino kit (Cook Medical, USA). Insertion was guided by a second physician – the bronchoscopist – using a bronchoscope for both visualization of initial needle puncture site and confirmation of adequate tracheostomy placement.

The Ambu® aScope™2 is a disposable, 5.4 mm diameter, camera-based bronchoscope. It connects to a small reusable video screen available with the unit and can also be connected to a larger monitor through a DPI port. Structure and controls of the Ambu® aScope™2 are similar to those found on an FOB. The current Ambu® aScope™2 lacks a suction port. The FOB typically used for PDT at the authors' institution has a diameter of 5.5 mm.

The present study was conducted in the ICU at the Royal Columbian Hospital in New Westminster, British Columbia, a 402-bed tertiary care facility. The Royal Columbian Hospital is the trauma, neurosurgical and cardiac referral centre for 1.6 million people. The ICU is a mixed medical/surgical facility with 20 ventilated beds and >800 admissions per year. The patient population includes a broad range of diagnoses including general medical ICU, trauma, neurosurgical and complicated postoperative cardiovascular patients.

All patients who were deemed appropriate for a PDT in the ICU were potentially included; the evaluation continued until all 22 available Ambu® aScopes™ were used. The bronchoscopist could elect not to use the Ambu® aScope™ based on their clinical impression of anticipated technical difficulty, the anticipated need to for a suctioning port during the procedure, and/or the need to perform a diagnostic bronchoscopy immediately following or preceding the PDT procedure. In all cases, an FOB was ready at the patients' bedside for immediate use. A closed suction catheter system was used to suction the endotracheal tube before the procedure to optimize the chances for success.

The incidence of cross-over to a fibreoptic video bronchoscope was recorded. After the procedure, the bronchoscopist was asked to complete a short, four-item questionnaire with an opportunity for open-ended feedback at the bottom of the form. 'Adequacy' and 'Conversion to regular bronchoscopy' were captured as yes/no answers. 'Ease of use' and 'visualization' were captured using a 10-point Likert-type scale, in which 10 was perfect and 1 was inadequate for the procedure (11).

This project was performed as a quality improvement evaluation of the Ambu® aScope™2. A memorandum of exemption was provided by the Fraser Health Research Ethics Board according to the Tri-Council Policy Statement 2: Ethical Conduct for Research Involving Humans, Article 2.5.

RESULTS

Twenty-two percutaneous tracheostomies were performed using the Ambu aScope™2 from September 9, 2012 to January 3, 2013. There were 30 tracheostomies in total performed in the ICU over this time period.

One conversion to a FOB occurred during the 22 procedures due to bleeding and the need for ongoing suction, resulting in an approximate 5% conversion rate (Table 1). The rate of completion of the postprocedure questionnaire was 73% (16 of 22). The mean score for the 'ease of use' category was 8.19 (range 6 to 10). The mean score for 'visualization' was 6.1 (range 2 to 10). Visualization with Likert scores ≤3 (19% [three of 16]) had associated comments included in Table 2.

DISCUSSION

Our series demonstrated that, in a general ICU population, the Ambu aScope™ 2 performed adequately for PDT in a population selected for ease of use. Our recommendation would be that PDT procedures using the Ambu® aScope™2 should have an FOB readily available should visualization issues or the need for suction be encountered. Furthermore, successful use of the Ambu aScope™ 2 will depend on an easily accessible suctioning apparatus with the ability to provide suction before and during the procedure when necessary. It is likely that next-generation disposable bronchoscopes will integrate a suction port.

There were no negative sequelae in our series using the Ambu® aScope™2. However, the present study involved a small nonsequential series of patients. Concerns were raised by a minority of operators regarding the potential need for suctioning rapidly and the light intensity of the Ambu® aScope™2, particularly if there is a need for bright transtracheal illumination during the procedure. It should be noted that patients were preselected for the present series because clinicians could 'opt out' based on patient and clinical characteristics, although this occurred in only eight cases. These findings may not apply to patients with more difficult anatomy or those who require ongoing suctioning throughout PDT.

ICUs can be 'hostile environments' for FOBs due to the acuity of patients, the multiplicity of care providers, and the decreased amount of control over the environment compared with the operating theatre or bronchoscopy suite. A recent cost analysis of fibreoptic bronchoscopy in the anesthetic suite yielded a cost of $94.95 per procedure inclusive of repair, capital, cart and processing costs over the anticipated five years of use (12). This likely underestimates the costs in an ICU, where environments may not be as controlled as in the anesthetic suite, and the damage requiring repair is likely higher than the 1.2% of procedures found in the study conducted in the anesthetic suite. Furthermore, our institution has significantly higher processing costs for FOB than quoted in the study (CAD$45 versus US$17.88). In the four years between 2009 and 2013, our ICU FOB was subject to $23,533 in repair costs. The original capital cost of the FOB was $26,603. Assuming a five-year capital cycle for this item and a relatively consistent 100 percutaneous tracheostomy procedures in our ICU per year, the approximate cost per use of the FOB for percutaneous tracheostomy – including capital, repairs and reprocessing in our ICU – is approximately $157.03. Depending on their price point and local arrangements, disposable bronchoscopes may not yield appreciable cost savings and, in fact, may be more expensive than FOBs depending on the cost of the disposable Ambu® aScope™. Approximate cost of a

disposable bronchoscope is approximately CAD$200. Not accounted for elsewhere and warranting consideration is the environmental impact of such a one-time use product.

Our institution found that these disposable bronchoscopes are a reasonable alternative to FOBs but need to be used with suitable safety precautions in place and in an appropriate patient population. There may be a role for an inexpensive bronchoscope that provides adequate visualization and does not require the gentle care needed for glass-fibre (ie, fibreoptic)-based bronchoscopes in a busy ICU environment. Furthermore, the disposable bronchoscopes do not require sterile processing, thereby avoiding potential infection control issues and the inconvenience of processing downtime. As a result of the present trial, our ICU has elected to use this device for most of our noncomplicated PDT procedures.

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