MESSAGE FROM THE EDITOR-IN-CHIEF / MESSAGE DU RÉDACTEUR EN CHEF
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ORIGINAL ARTICLES
Mechanical insufflation-exsufflation: Practice patterns among respiratory therapists in Ontario
Intra- and inter-rater reliability of maximum inspiratory pressure measured using a portable capsule-sensing pressure gauge device in healthy adults
A single-centre case series assessing the Ambu® aScope™ 2 for percutaneous tracheostomies: A viable alternative to fibreoptic bronchoscopes
TUDORZA GENUAIR demonstrated a statistically significant improvement in lung function (morning pre-dose [trough] FEV1) at 24 weeks vs. placebo (TUDORZA GENUAIR 400 mcg BID, 55 mL vs. placebo, -73 mL, p<0.0001)\(^{11,12}\).

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- Should not be used more frequently than twice daily.
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**REFERENCES:**


\(^{*}\) A randomized, double-blind, placebo-controlled, 24-week study in patients aged ≥40 years (N=819) with a clinical diagnosis of stable moderate-to-severe COPD (post-bronchodilator FEV1 of ≥30% to <80% of predicted normal value) and a history of smoking of at least 10 pack-years. Morning trough (pre-dose) FEV1 was defined as FEV1, measured 12 hours after the previous evening dose of TUDORZA GENUAIR.
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MESSAGE FROM THE EDITOR-IN-CHIEF / MESSAGE DU RÉDACTEUR EN CHEF

Growing our professional journal / L’expansion de notre revue professionnelle

Jason Nickerson

ORIGINAL ARTICLES

Mechanical insufflation-exsufflation: Practice patterns among respiratory therapists in Ontario

Shelley Prevost, Dina Brooks, Phillip T Bwititi

Respiratory muscle weakness resulting from conditions such as neuromuscular disease can lead to respiratory infection, hospitalization and serious pulmonary complications. Secretion clearance from the airways is correlated with peak expiratory cough flow, which can be enhanced by physical manoeuvres coupled with manual or mechanical resuscitator devices. Cough-assistance devices, such as the mechanical insufflator-exsufflator, can increase inspiratory lung volumes and peak expiratory cough flows beyond the patient’s spontaneous ability and significantly augment lung secretion clearance. This study was prompted by the lack of data regarding current practices and availability of mechanical insufflator-exsufflator devices in Canada.

Intra- and inter-rater reliability of maximum inspiratory pressure measured using a portable capsule-sensing pressure gauge device in healthy adults

Nikita S Jalan, Sonam S Daftari, Seemi S Retharekar, Savita A Rairikar, Ashok M Shyam, Parag K Sancheti

Measurement of inspiratory pressure is the cornerstone of assessing inspiratory muscle strength. Tools to measure this parameter, both invasive and noninvasive, are diverse but have associated advantages and disadvantages. Although noninvasive techniques are preferred because of their simplicity, there is an absence of data regarding the reliability of currently available noninvasive devices to measure this important metric. This study investigated the efficacy of a relatively inexpensive device that can be used in typical clinical settings.

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

Steven Reynolds, Jason Zurba, Laura Duggan

Practiced for millennia, tracheostomy remains one of the most common procedures performed in the intensive care unit to facilitate ventilation. Although its safety has been augmented by bronchoscopy, reports describing patient injuries and/or bronchoscope damage have been published. This prospective quality improvement study evaluated whether a particular single-use flexible intubation scope could mitigate bronchoscope repair costs while still providing safe and timely percutaneous dilational tracheostomy.

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Growing our professional journal

Welcome to the current issue of the Canadian Journal of Respiratory Therapy (CJRT). With this issue, the Journal continues on its path to strengthen, promote, and expand research by and for respiratory therapists. We are now several months into our new format with our publisher, Pulsus Group, and it is a good time to revisit the progress that has been made since doing so.

We are committed to improving the quality of the Journal and ensuring it responds to the information needs of Canadian respiratory therapists, while serving a broader role in improving respiratory care throughout the world. To achieve this, the Journal has recruited an editorial board, consisting of experts from Canada and around the world. By bringing together this international expertise, we build the quality of the Journal, and also look for new opportunities to reach readers and authors in other countries.

Along similar lines, we are expanding the indexing of this Journal in major international databases, including HINARI, a program established by the World Health Organization, which enables health professionals in low- and middle-income countries to gain access to biomedical and health literature. The CJRT is now indexed in HINARI, and we are committed to ensuring that the research that we publish is available globally, which is reinforced by our Journal remaining available online and open access.

Additionally, we are improving the ability of readers to identify articles in the CJRT through indexing in Google Scholar. This will ensure that our articles are easily retrievable and accessible to authors who are looking for them, and helps to ensure that works submitted to the Journal are more widely read, cited and used as part of patient care.

We continue to pursue additional opportunities for indexing in other major databases, and are continuing to grow the Journal in new ways. We are seeking feedback from our readers, and will be launching an online survey to better understand how you use the Journal, what features you enjoy, which ones needs to be improved, and how we can better position the Journal to address your information needs as a professional and as a clinician. We are firmly committed to continuing to expand the scope and quality of the CJRT, but need your input to guide us.

Finally, I want to thank the members of our editorial team, including our new editorial board, our associate editors, our managing editor and the Canadian Society of Respiratory Therapists, who continue to support the Journal’s success. Without all of these individuals, we would not have the Journal that we have today. Publishing is a considerable amount of work, and my continued thanks goes out to all of those involved.

Jason Nickerson RRT FCSRT PhD, Editor-in-Chief

L’expansion de notre revue professionnelle

Bienvenue au présent numéro du Journal canadien de thérapie respiratoire (JCTR). Dans ce numéro, le Journal poursuit son parcours pour renforcer, promouvoir et accroître la recherche par et pour les inhalothérapeutes. Il y a déjà quelques mois que nous avons adopté la nouvelle formule avec notre éditeur, Pulsus Group, et il est temps d’évaluer les progrès réalisés.

Nous sommes déterminés à améliorer la qualité du Journal et à nous assurer qu’il répond aux besoins d’information des inhalothérapeutes canadiens tout en jouant un rôle plus vaste; soit l’amélioration des soins respiratoires au niveau mondial. À ce but, le Journal a recruté un comité de rédaction composé d’experts Canadian, ainsi qu’au niveau international. Grâce à ces compétences internationales, nous accroisons la qualité du Journal et favorisons les occasions d’atteindre des lecteurs et des auteurs d’autres pays.

De même, nous étendons l’indexation du Journal à de grandes bases de données internationales, y compris HINARI, un programme mis en place par l’Organisation mondiale de la santé afin de permettre aux professionnels de la santé de pays à faible et moyen revenu d’accéder aux publications en sciences biomédicales ou médicales. Le JCTR est donc indexé dans HINARI, et nous nous engageons à ce que les résultats de recherches que nous publions puissent être consultés dans le monde entier. C’est pourquoi le Journal continue d’être accessible en accès ouvert par Internet.

De plus, les lecteurs pourront trouver les articles du JCTR plus facilement grâce à l’indexation dans Google Scholar. Ainsi, nos articles seront faciles à récupérer, seront accessibles aux auteurs qui les cherchent et seront davantage lus, cités et utilisés dans le cadre des soins aux patients.

Nous cherchons toujours à accroître les possibilités d’indexation dans d’autres grandes bases de données et sommes à l’affût de nouvelles façons de faire croître le Journal. Pour connaître l’avis des lecteurs, nous lancerons un sondage virtuel afin de mieux comprendre comment vous utilisez le Journal, les chroniques que vous préférez, celles qui ont besoin d’être améliorées et quoi faire pour que le Journal réponde à vos besoins d’information à titre de professionnel et de cliniciens. Nous sommes déterminés à continuer d’accroître la portée et la qualité du JCTR, mais avons besoin de vous pour nous orienter.

Enfin, je tiens à remercier les membres de l’équipe éditoriale, y compris le nouveau comité de rédaction, les rédacteurs adjoints, le rédacteur en chef et la Société canadienne des thérapeutes respiratoires, qui continuent de soutenir la réussite du Journal. Sans eux, le Journal ne serait pas ce qu’il est aujourd’hui. L’édition exige un travail énorme, et je remercie tous ceux qui y participent.

Jason Nickerson RRT FCSRT Ph. D., rédacteur en chef

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The Canadian Journal of Respiratory Therapy (CJRT) is an open access, peer reviewed publication. We strive to publish manuscripts that describe effective interventions that increase access to and quality of clinical respiratory health interventions, including the organization and delivery of care in hospitals, the community, and throughout the continuum of care by health care providers.

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Mechanical insufflation-exsufflation: Practice patterns among respiratory therapists in Ontario

Shelley Prevost RRT¹, Dina Brooks PhD², Phillip T Bwititi PhD³


BACKGROUND: The mechanical insufflator-exsufflator (MIE) is effective in assisting cough and in helping to avoid unplanned hospitalizations, tracheostomy and long-term ventilation in patients with neuromuscular disease or spinal cord injury. Despite this, the availability and usage of the device in Canada is unknown.

OBJECTIVE: To investigate practice patterns and availability of the MIE in Ontario hospitals.

METHODS: A cross-sectional, self-administered mail survey was sent to a random sample of 400 respiratory therapists practicing in 96 Ontario hospitals.

RESULTS: A total of 114 (28%) completed surveys were returned from 62 (65%) hospitals. Twenty (32%) hospitals had a MIE. The respiratory therapist was the predominant health care provider using the MIE. The device was most commonly used in the intensive care unit, and medical/surgical units in patients with neuromuscular diseases or spinal cord injuries. Optimal pressure spans of 35 cmH₂O to 40 cmH₂O were used by 54% of respondents. Fourteen of the 20 hospitals with an MIE had policies or guidelines in place, and four of these hospitals had established staff competencies. Measurements of peak cough flow, maximal inspiratory/expiratory pressure and vital capacity were reported to be infrequently performed.

CONCLUSIONS: The present study demonstrated that the MIE device is not widely available in Ontario hospitals and there are variations in how the devices are applied, possibly resulting in suboptimal therapy. A comprehensive educational program about MIE devices that incorporates best practices and a practical component is recommended for current providers as well as for inclusion in student curricula.

Key Words: Cough assist; Mechanical insufflation-exsufflation; Neuromuscular disease; Respiratory muscle weakness; Spinal cord injury

HISTORIQUE : L'insufflateur-exsufflateur mécanique (IEM) est efficace pour soulager la toux et éviter des hospitalisations non planifiées, des trachéotomies et une ventilation prolongée chez des patients ayant une maladie neuromusculaire ou un traumatisme médullaire. Pourtant, on ne sait pas quel est l'accès à l’IEM et quelle en est l'utilisation au Canada.

OBJECTIF : Examiner les modes de pratique et l'accès à l'IEM dans les hôpitaux ontariens.

MÉTHODOLOGIE : Un sondage transversal autoadministré a été posté à un échantillon aléatoire de 400 inhalothérapeutes qui exerçaient dans 96 hôpitaux ontariens.

RÉSULTATS : Au total, 62 hôpitaux (65 %) ont remis 114 sondages remplis (28 %). Vingt hôpitaux (32 %) avaient un IEM. L'inhalothérapeute était le principal dispensateur de soins à l'utilisateur. L'appareil était surtout utilisé à l'unité de soins intensifs, et aux unités médicales et chirurgicales auprès de patients ayant une maladie neuromusculaire ou un traumatisme médullaire. De plus, 54 % des répondants utilisaient des intervalles de pression optimaux de 35 cm d'eau à 40 cm d'eau. Quatorze des 20 hôpitaux ayant un IEM n'étaient pas dotés de politiques ou de lignes directrices, et quatre avaient établi des compétences pour le personnel. Le début de toux de pointe, la pression inspiratoire ou expiratoire maximale et la capacité vitale étaient peu mesurés.

CONCLUSIONS : La présente étude démontre que l'accès à l'IEM n'est pas généré dans les hôpitaux ontariens et que l'utilisation de cet appareil varie, ce qui s'associe peut-être à un traitement sous-optimal. Il est recommandé de préparer un programme de formation complet sur les IEM, qui allierait les pratiques exemplaires et un volet pratique, qui serait offert aux dispensateurs en exercice et qui serait intégré au cursus d'étude.

In neuromuscular disease and quadriplegia, respiratory muscle weakness can lead to deterioration in respiratory function causing frequent respiratory infection (1,2), hospitalization (3-5), tracheostomy and long-term ventilation (6,7). Pulmonary complications are frequent respiratory infection (1,2), hospitalization (3-5), tracheostomy and long-term ventilation in patients with neuromuscular disease or spinal cord injury. Despite this, the availability and usage of the device in Canada is unknown.

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Key Words: Cough assist; Mechanical insufflation-exsufflation; Neuromuscular disease; Respiratory muscle weakness; Spinal cord injury

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TABLE 1
Questionnaire format

<table>
<thead>
<tr>
<th>Section 1</th>
<th>Sociodemographics</th>
<th>Sex, age, years in practice, category and size of hospital, area of practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 2</td>
<td>Breath stacking and manually assisted cough</td>
<td>Cough assessment, breath stacking, manually assisted cough, availability of mechanical insufflator exsufflator</td>
</tr>
<tr>
<td>Section 3</td>
<td>Mechanical insufflation-exsufflation</td>
<td>Practice areas used, patient populations, interface, settings, availability of policy or guideline, established competencies, barriers to use, personal protective equipment</td>
</tr>
<tr>
<td>Section 4</td>
<td>Miscellaneous</td>
<td>Patient discharge, professional development needs</td>
</tr>
</tbody>
</table>

hospitlizations, tracheostomy and long-term ventilation (30-32) as well as improve survival (33,34).

There are numerous reports describing the positive effect of MIE in terms of quality of life (35,36) and reducing health care costs (3,13,37-39). In addition, personal preference by patients and care givers in terms of safety, convenience, appearance, comfort, and preservation of speech and swallowing has also been demonstrated (6,40-42). Despite these published findings, MIE appears to be underutilized (30,41). To our knowledge, there has been only one published study that attempted to assess the use of MIE in terms of provider knowledge, facility type, clinical practice and provider satisfaction (40). Schmitt et al (40) mailed 525 questionnaires to members of the American Paraplegia Association and obtained a response rate of 16% (n=86), representing 76 hospitals. The authors found that 49% (n=37) of these hospitals reported having the device. Other findings from this study include the mean pressure used (37 cmH2O); that tracheostomy was the most common interface used; and protocols were used in 56% of hospitals.

No data regarding the current practices or availability of MIE in Canada are available. Hence, the aim of the present research was to investigate and describe the availability of the MIE in Ontario hospitals and the relevant practice patterns of respiratory therapists.

METHODS

Study design

The present study was a cross-sectional, self-administered mail survey using a modified Dillman method (43). Ethics approval was obtained from St Joseph’s Care Group Research Ethics Board (Protocol number 20080022), Ontario, and Charles Sturt University Human Research Ethics Committee (Protocol number 2008/1169) New South Wales, Australia. Between March 2009 and June 2009, surveys were sent to the employer address of 400 randomly selected respiratory therapists working in hospitals in Ontario. The sample size of 400 was determined by budgetary limitations of the study. All potential respondents and surveys were coded with a facility and respondent identification number to avoid repeat mailings. The questionnaire was sent with an information letter that included background information, the purpose of the research, statement of confidentiality and contact information if the respondent had questions. A second questionnaire was mailed four weeks after the initial mailing and a third reminder questionnaire was sent four weeks after the second reminder to nonrespondents. A postage-paid envelope was included with every survey sent to each potential respondent.

Sample

The College of Respiratory Therapists of Ontario (CRTO) provided business contact information for respiratory therapists in Ontario from the public register of members in accordance with legislation and by-law. There was a total of 2516 respiratory therapists registered with the CRTO. Using a computerized random number function, a random sample of 400 respiratory therapists employed in Ontario was drawn from the public register of respiratory therapists by the researcher.

Questionnaire development

The questionnaire was developed by the researchers based on a review of the literature (1-42,44,45), the previous clinical practice survey by Schmitt et al (40) and consulting with health care providers with expertise in MIE. The questionnaire was restricted to practicing respiratory therapists in Ontario, in contrast with Schmitt et al who surveyed members of the American Paraplegia Society, which included physicians, clinicians and researchers as well as patients. Both questionnaires sought to acquire information about the respondent’s facility, availability of the device, whether a protocol was used, whether there was established staff competencies for use of the device, device settings and types of interfaces commonly used. In addition, the questionnaire sought information to describe practice patterns regarding assessment procedures, other adjunct interventions, such as breath stacking, device use in specific patient populations and specific areas of clinical practice as well as perceived barriers to using the device. The questionnaire was also designed to describe the demographics of the respondents and compare that with the provincial demographic data available through the CRTO. The questionnaire was pretested by six respiratory therapists and two respirologists who were not involved in the development of the questionnaire. The purpose of the pretest was to estimate the length of time to complete the questionnaire as well as to review the clarity and acceptability of the content and format. Feedback resulted in rewording of three questions to improve clarity, the addition of one question and deletion of two less relevant questions. The types of survey questions included scale, multiple choice, and numerical as well as inviting comments to allow respondents to write an optional response. The final questionnaire was 11 pages in length, consisted of 33 questions and was divided into four sections as summarized in Table 1. It was estimated that the questionnaire would take 20 min to complete.

Data analysis

Statistical analysis was performed using SPSS version 15 (IBM Corporation, USA). A descriptive summary and frequency analysis of the data on questions were performed. To assess comments, content of responses were coded to determine themes or patterns.

RESULTS

Response rate and demographics

In total, 147 surveys were returned (37% response rate) from 70 (73%) hospitals. Inconsistency between two surveys from the same facility was clarified by telephone call and resulted in one survey being discarded because both surveys were completed by the same individual working in different hospital areas. Surveys returned incomplete included four surveys from respondents who did not give a reason; three from respondents who reported the survey was not applicable to their practice (working in infection control, echocardiography or cancer hospital); and 25 returned by the employer hospital because the respiratory therapist was no longer employed at that hospital. Of those eligible, 114 surveys were complete, corresponding to an overall response rate of 28%; these surveys were from 62 hospitals (65%) (Figure 1). Multiple responses from hospitals were allowed.

Among the 114 respondents, the majority were women (76%). The higher proportion of responses from women was not significantly different from the overall proportion of women reported by the CRTO in their Annual Report 2008/2009 (46). The percentage distribution of respondents according to age showed that the majority of respondents were between 30 and 39 years of age. The majority of CRTO members were between 40 and 49 years of age (Table 2). Ninety percent of respondents reported that they worked in an acute care facility,
MIE: Practice patterns among respiratory therapists in Ontario

TABLE 2
Comparison of respondent demographic characteristics with members of the College of Respiratory Therapists of Ontario (CRTO)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Respondents</th>
<th>CRTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>28 (24)</td>
<td>765 (29)</td>
</tr>
<tr>
<td>Female</td>
<td>86 (76)</td>
<td>1858 (71)</td>
</tr>
<tr>
<td>Age, years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30</td>
<td>22 (19)</td>
<td>455 (17)</td>
</tr>
<tr>
<td>30–39</td>
<td>43 (37)</td>
<td>830 (32)</td>
</tr>
<tr>
<td>40–49</td>
<td>34 (30)</td>
<td>903 (34)</td>
</tr>
<tr>
<td>≥50</td>
<td>15 (14)</td>
<td>435 (17)</td>
</tr>
</tbody>
</table>

Data presented as n (%)

TABLE 3
Characteristics among respondents practicing, not practicing or unfamiliar with a mechanical insufflator-exsufflator

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Practice</th>
<th>Do not practice</th>
<th>Unfamiliar</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>44</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>Female sex, %</td>
<td>73</td>
<td>77</td>
<td>80</td>
</tr>
<tr>
<td>Work in acute care setting, %</td>
<td>91</td>
<td>97</td>
<td>100</td>
</tr>
<tr>
<td>Years in practice, mean ± SD</td>
<td>12.8±8.0</td>
<td>15.6±10.3</td>
<td>13.0±7.4</td>
</tr>
<tr>
<td>Minimum years in practice</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Maximum years in practice</td>
<td>36</td>
<td>39</td>
<td>24</td>
</tr>
</tbody>
</table>

Multiple responses allowed

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used by 54% of respondents. There was agreement among respondents for example, optimal pressure spans of 35 cmH\textsubscript{2}O to 40 cmH\textsubscript{2}O were although responsibility was shared with physical therapists and nurses an MIE. The device was used predominantly by respiratory therapists, in the present study, one-third of the Ontario hospitals surveyed have (n=39 [61%]), and fearing patient injury or discomfort (n=35 [55%]). Appropriate patients (n=42 [66%]), having a lack of skill in the manoeuvres coughs identified barriers to be a lack of knowledge in identifying appropriate patients (n=48 [67%]), lack of knowledge in performing breath stacking (n=45 [62%]) and a lack of knowledge of the benefits to this technique (n=40 [56%]).

**Adjuncts to MIE**

**Cough assessment:** Respondents (n=114) were asked about the frequency of performing PCF, maximal inspiratory/expiratory pressure, vital capacity or a subjective evaluation as part of an initial assessment of the effectiveness of a patient’s cough. The majority of respondents reported they performed a subjective evaluation most of the time (n=68 [67%]). PCF was measured most of the time by 23% of respondents (n=24) and vital capacity was measured most of the time by 29% (n=30). Maximal inspiratory/expiratory pressure was reported by 11% of respondents (n=12) to be measured most of the time (Figure 3).

**Breath stacking with modified manual resuscitator:** Sixty-four percent (n=73) of respondents had experience in breath stacking using a modified manual resuscitator with one-way valves. The most prevalent barriers to performing breath stacking included difficulty with mask and/or mouthpiece seal (n=59 [82%]) and patients referred in the late stage of disease (n=52 [73%]). Other barriers cited included lack of knowledge in identifying appropriate patients (n=48 [67%]), lack of skill in performing breath stacking (n=45 [62%]) and a lack of knowledge of the benefits to this technique (n=40 [56%]).

**Manual assisted cough:** Fifty-six percent of respondents (n=64) performed assisted cough manoeuvres (eg, abdominal thrust or lateral costal compression) in their practice. Of those who performed assisted cough manoeuvres, it was done to augment a spontaneous cough and to augment breath stacking. Of the respondents who use an MIE, one-half (24 of 43) reported that they performed assisted cough manoeuvres to augment MIE. The 64 respondents performing manual assisted coughs identified barriers to be a lack of knowledge in identifying appropriate patients (n=42 [66%]), having a lack of skill in the manoeuvres (n=39 [61%]), and fearing patient injury or discomfort (n=35 [55%]).

**DISCUSSION**

In the present study, one-third of the Ontario hospitals surveyed have an MIE. The device was used predominantly by respiratory therapists, although responsibility was shared with physical therapists and nurses in some institutions. There was variation in how the device was applied. For example, optimal pressure spans of 35 cmH$_{2}$O to 40 cmH$_{2}$O were used by 54% of respondents. There was agreement among respondents that the MIE was used primarily in individuals with neuromuscular disease or spinal cord injury, and that adverse events were rare in these patient populations.

To our knowledge, only the study by Schmitt et al (40) was designed to examine the use of the MIE and the attitudes among members of the American Paraplegia Society. These authors reported that 49% of the institutions surveyed had the device, while our study reports 32%. While we found that tracheostomy, face mask and mouthpiece interfaces were used equally with the MIE, this is in contrast to Schmitt et al (40), who reported tracheostomy to be the most common interface used. This difference may be attributed to respondents in the study by Schmitt et al (40) having experience primarily with individuals with spinal cord injury. In comparison, our study targeted professionals who most likely had experience with patients presenting with a variety of disorders. Regarding the use of protocols and guidelines, we found that 70% of hospitals using the device had a specific protocol and 29% had staff competencies, compared with Schmitt et al (40) who reported 56% of institutions had a specific protocol and 63% of those hospitals had staff competencies.

A small number of respondents indicated they performed objective bedside measurements, such as vital capacity, PCF or maximal inspiratory/expiratory pressures, to evaluate cough effectiveness and the need for MIE. This finding may suggest a lack of awareness on how to interpret these measurements in patients with neuromuscular disease and spinal cord injury. One of the easiest and fastest bedside measurements is PCF using a peak flow meter. This parameter may be an important measure for clinical decision making. Bach and Saporito (18) studied 49 individuals with neuromuscular ventilatory impairment and found that an assisted PCF $\geq$160 L/min was the only measurement found to safely predict successful extubation or decannulation irrespective of the extent of ventilator dependence. It has also been noted that respiratory muscle strength deteriorates during respiratory tract infection, such that individuals with marginal respiratory strength when stable are at risk for their PCF falling below the critical threshold of 160 L/min when enduring an infection (12). Bach et al (7) found that none of the patients with Duchenne muscular dystrophy with an assisted PCF $\geq$270 L/min developed acute respiratory failure with respiratory infection. Two studies demonstrated an improved survival rate when patients were weaned from tracheostomy support (33,34). Hence, measuring and enhancing PCF is important.

In the present survey, 54% of respondents used pressure spans in the range of 35 cmH$_{2}$O to 40 cmH$_{2}$O. Gomez-Merino et al (44) demonstrated insufflation-exsufflation spans $<$35 cmH$_{2}$O did not achieve expiratory flows of 160 L/min. Faroux et al (45) studied pediatric patients with neuromuscular disease and found 40 cmH$_{2}$O to be the only pressure span associated with improvement in PCF and...
respiratory comfort. Significant improvement in blood oxygen saturation was occurred only after 40 cmH2O by Winck et al (38). Among our respondents, usage was reported at 30 cmH2O as well as 10 cmH2O to 25 cmH2O, all of which are inadequate to fully expand the lungs, which may result in suboptimal treatment effects that could be interpreted as treatment failure. Sixty percent (n=23) of respondents used inspiratory time settings <3.0 s. Sancho et al (39) found that as set insufflation time was increased, the generated exsufflation flow was significantly increased at each pressure setting. Increasing insufflation time resulted in significantly greater exsufflation volume and flow with 3 s insufflation time yield higher exsufflation volume and flow compared with 2 s. Insufflation time <3 s may not fully expand the lungs. These findings suggest there could be a lack of awareness of the most effective device settings for pressure span and insufflation time.

Respiratory therapists are the predominant health care providers using MIEs. Because respondents reported workload issues to be their most significant barrier to performing MIE, this finding may suggest there is opportunity to raise awareness among other health care providers, such as physical therapists and nurses, which could increase availability of the therapy. Future studies should investigate whether other health care providers could play a greater role in the delivery of the therapy.

Data from the present study indicate that MIE was used mostly after hospital admission. However, these patients present to the emergency department first, and the infrequent use of the MIE in the emergency department may, therefore, delay therapy. Further research is needed to determine whether the use of these devices in the emergency department could prevent admission to the intensive care unit or prevent severe deterioration.

One-third of respondents had not used a modified manual resuscitator for breath stacking and 8% of these respondents reported being unfamiliar with the set-up. Respondents with experience in breath stacking reported different barriers to performing breath stacking compared with respondents without experience. Because one-half of the experienced users identified lack of skill as a barrier, we recommend a strong practical component be included in educational programs to improve clinical skill as well as knowledge. Similarly, respondents identified a lack of skill (61%) as a barrier to performing assisted cough manoeuvres, suggesting that practical experience is an important component of learning in addition to didactic teaching.

The limitations of the present study are those characteristic of survey research. It is possible that respondents had strong opinions about MIE and may not be representative of actual practice. Lower response rates have been reported with mail surveys (47); however, the use of repeated mailings can enhance the response rate (48,49). Mailing the survey to the respondent’s business address could have negatively influenced the response rate due to loss of survey within the institution. The length of the questionnaire (32 questions) may also have contributed to the response rate. Other reasons for this response rate could include survey fatigue, survey loss, time and general indifference (49). Nonetheless, our response rate (28%) was nearly double that of Schmitt et al (40) (16%). A further limitation of the present study was its lack of generalizability to larger populations (eg, the Canadian respiratory therapist population or respiratory therapists in other countries). A survey sample restricted to one province does not allow for widespread generalization of the findings to other provinces or Canada. Despite the known limitations, the present study is an important first step to understanding the practice patterns among respiratory therapists with regard to MIE.

CONCLUSION

The present study demonstrated that the MIE device is not widely available in Ontario hospitals and there are variations in how the devices are applied, possibly resulting in suboptimal therapy. A comprehensive educational program about MIE devices that incorporates best practices and a practical component is recommended for current providers as well as for inclusion in student curricula. Future research could address educational needs on a national scale and also in other stakeholder health groups such as physicians.

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Intra- and inter-rater reliability of maximum inspiratory pressure measured using a portable capsule-sensing pressure gauge device in healthy adults

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BACKGROUND: Measurement of maximum inspiratory pressure is the most prevalent method used in clinical practice to assess the strength of the inspiratory muscles. Although there are many devices available for the assessment of inspiratory muscle strength, there is a dearth of literature describing the reliability of devices that can be used in clinical patient assessment. The capsule-sensing pressure gauge (CSPG-V) is a new tool that measures the strength of inspiratory muscles; it is easy to use, noninvasive, inexpensive and lightweight.

OBJECTIVE: To test the intra- and inter-rater reliability of a CSPG-V device in healthy adults.

METHODS: A cross-sectional study involving 80 adult subjects with a mean age of 22±3 years was performed. Using simple randomization, 40 individuals (20 male, 20 female) were used for intrarater and 40 (20 male, 20 female) were used for inter-rater reliability testing of the CSPG-V device.

RESULTS: The intrarater reliability ICC was 0.962 and the inter-rater reliability ICC was 0.922.

CONCLUSION: Results of the present study suggest that maximum inspiratory pressure measured using a CSPG-V device has excellent intra- and inter-rater reliability, and can be used as a diagnostic and prognostic tool in patients with respiratory muscle impairment.

Key Words: Intrarater reliability; Inter-rater reliability; Maximal inspiratory pressure; MIP; Noninvasive device for maximum inspiratory pressure measurement

Measurement of maximum inspiratory pressure (MIP) is a simple, quick and noninvasive clinical procedure for determining inspiratory (diaphragm, abdominal, intercostal and accessory) muscle strength both in healthy subjects, and in patients with pulmonary or neuromuscular diseases (3). MIP is the greatest subatmospheric pressure that can be generated during inspiration against an occluded airway. It is a relatively simple and inexpensive measurement to perform (4). It reflects the force-generating ability of the combined inspiratory muscles during a brief-static contraction (5), thus reflecting the strength of the respiratory muscle. The capsule-sensing pressure gauge (CSPG-V, Gauges Bourdon [I] Pvt Ltd, India [Figure 1]) is a new tool that measures mouth pressure, which is classically established as the standard for assessment of inspiratory muscle strength. This particular CSPG-V was designed, tested and calibrated by an ISO 9001-certified company.
(General Instruments Consortium Company, India). It is a small, handheld, portable, lightweight, noninvasive, nonbattery-powered, inexpensive device with a mouth pressure manometer attached to a flexible tube with a plastic rigid flanged mouthpiece and a small monitor that displays the test results in cmH2O. This device measures pressure in the range of ~500 cmH2O to 0 cmH2O with markings at every 5 cmH2O; accuracy is rated as ±5 cmH2O.

MIP measurement is not routinely performed during pulmonary function testing. It is indicated when muscle weakness is a suspected contributing cause of abnormal results from routine testing, such as a low vital capacity or reduced forced expiratory volume without signs of obstruction, or an abnormality of the flow volume loop that is recognized to be associated with muscle weakness or if muscle weakness is a possibility in the given clinical scenario. Weakness of the respiratory muscles may be present in patients with dyspnea; respiratory failure; neuromuscular diseases, such as myasthenia gravis, Guillain-Barré syndrome, amyotrophic lateral sclerosis, stroke, polio or quadriplegia; and in multisystem diseases such as polymyositis and sarcoidosis (6). MIP is also used to monitor patients with acute conditions (myasthenia gravis, motor neuron diseases, etc) who are at risk for rapid loss of strength in inspiratory muscles, to follow the progress of patients with chronic diseases (chronic obstructive pulmonary disease [COPD], muscular dystrophy) and also to detect muscle weakness in undiagnosed patients. There is an increased awareness that respiratory muscle weakness can be a compounding factor in other disease processes, such as malnutrition, and steroid therapy (3). Apart from having a role in the diagnosis and prognosis of several neuromuscular and pulmonary disorders, respiratory muscle weakness is also associated with health status, physical fitness and even postsurgical general morbidity/mortality of an individual (4).

For example, inspiratory muscle training after assessment using an MIP device has been reported to be useful in COPD when patients presented with significant respiratory muscle weakness, and also showed that tapering of oral corticosteroid successfully restored the respiratory muscle strength and improved dyspnea in patients with corticosteroid-induced myopathy (7). MIP is also helpful in evaluating the success of weaning patients from mechanical ventilators and in predicting the outcome of cardiac transplantation surgery in patients with chronic congestive heart failure (8). Maximum mouth pressure measurements with some portable manometers have been found to be reliable and valid both in healthy volunteers as well as pulmonary and neuromuscular disease patients. However, to our knowledge, there is little awareness of these portable devices because they are scarcely available in a developing country such as India. Also, previous manometer reliability studies used inappropriate or insufficient statistical indexes of reliability (eg, Pearson correlation coefficient), which makes their assumptions problematic (2).

The objective of the present study was to develop evidence regarding the intra- and inter-rater reliability of MIP using a CSPG device in healthy adults so that it can be readily used in a typical clinical setting; thereby facilitating enhanced patient care with inspiratory muscle weakness of various causes.

METHODS

The present analysis was a cross-sectional study approved by the Institutional Ethics Committee of Sancheti Institute for Orthopedics and Rehabilitation (Maharashtra, India), a tertiary health care centre. Informed written consent was obtained from all participants.

A sample of 40 healthy adults (20 male, 20 female) was recruited for intrarater and 40 healthy adults (20 male, 20 females) for inter-rater reliability using a simple randomization technique. The sample size was calculated based on a sample size calculation technique. The mean (± SD) age was 22.3± years. Excluded from analysis were smokers; individuals with respiratory tract infection within two weeks of data collection (9); individuals with congenital or acquired cardiac or respiratory disease; and neurological and musculoskeletal conditions involving the respiratory system because these are known to influence respiratory function. The demographic characteristics of all participants were noted. Participants were seated comfortably on a chair with their back supported. MIP was measured using the CSPG-V according to American Thoracic Society (ATS) guidelines.

CSPG-V

A small leak was introduced between the occlusion and the mouth to prevent glottis closure. During MIP measurement, the participant was asked to hold the gauge with both hands and to close his or her lips firmly around the flanged mouthpiece. A nose clip was applied to avoid nasal air leak and the participants were asked to exhale as much as possible (to residual volume) and then to inhale maximally for >1 s against the resistance of the gauge. The subjects performed three inspiratory efforts, with each effort sustained for at least 1 s. Strong verbal encouragement was given during the test (7). The best of the three inspiratory efforts was used for analysis. An interval of approximately 1 min was allowed to elapse between each effort. At the beginning of the testing sessions, instructions about the procedure were given in a standardized manner and all measurements were performed by an appropriately trained physical therapist. The measurements occurred at the same time of day for each participant. To assess intrarater reliability, a physical therapist assessed 40 subjects twice. Measurements were separated by one day, and the therapist was blinded to the results. To assess inter-rater reliability, two therapists performed measurements on 40 subjects, separated by one day and blinded to one another's readings. These results were used for data analysis.

Data analysis was performed using SPSS version 12.0 (IBM Corporation, USA) and the results were analyzed using intraclass correlation coefficient (ICC) for intra- and inter-rater reliability testing of the CSPG device.

RESULTS

Table 1 summarizes the intrarater data and Table 2 summarizes the inter-rater data; Figure 2 and Figure 3 depict the mean for MIP of intrarater reliability testing (ie, A1 and A2) while Figure 4 and Figure 5 depict the mean for MIP of inter-rater reliability testing (ie, rater 1 and rater 2). The ICC for intrarater testing was 0.962 and ICC for inter-rater testing was 0.922. Statistical significance was set at P=0.05. ICC values >0.6 are considered to be acceptably reliable, while ICC values >0.8 are considered to be highly reliable (10). The maximal value of an ICC is 1.0, which indicates perfect intra-subject reproducibility; it is accepted that a test should have an ICC of at least 0.60 to be useful (11).

DISCUSSION

The present study provides new insight regarding the intra- and inter-rater reliability of a CSPG-V device, supporting its use for assessment and treatment of patients with inspiratory muscle weakness.
The intrarater reliability ICC was 0.962 and inter-rater reliability ICC was 0.922, suggesting that the CSPG-V device is a highly reliable tool for assessing respiratory muscle strength with high accuracy because the reliability is >0.8 and does not require a high number of repetitions for its accuracy. In the present study, we also found that the mean MIP was 82.82±32.76 cmH2O, which is consistent with the normal range reported in a study conducted by Wilson (12) involving 135 Caucasian adults >18 years of age.

The method that was adopted for MIP measurement in the present study was incorporated according to the standard method recommended by the ATS, in which the ATS authors reviewed studies of flanged mouthpieces versus tube mouthpieces. The authors commented that the values obtained using a flanged mouthpiece were less than with a tube mouthpiece, but recommend the flanged mouthpieces as the standard because they are easier for patients to use (1). In the present study, we also attempted to overcome a learning effect by allowing three repetitions, which likely altered the MIP. Clanton and Diaz (13) also reported a considerable learning effect up to the fifth to ninth MIP trial.

To our knowledge, there is currently no device to assess inspiratory muscle strength available in India that is portable, easy to use and reliable. Our study is comparable with other studies performed by international institutions that have also performed reliability testing of portable manometers. In one study, Dimitriadis et al (2) focused on the test/retest reliability of MicroRPM portable manometer’s measurements of MIP and maximum expiratory pressure, which were sitting and standing for three sessions at an interval of one week each for 15 individuals. ICCs for MIP and maximum expiratory pressure in the sitting position were 0.86 and 0.90, and were 0.78 and 0.83 for the standing position. The reliability generated in the sitting position in that study was comparable with our study, with ICC values of 0.962 (intrarater) and 0.922 (inter-rater), thus making both portable devices comparable. It is also clear that MIP is best measured in seated patients, compared with standing.

A study performed by Maillard et al (11) reported high reliability using a mouth pressure meter (Chest Scientific Instruments Ltd, United Kingdom) on the measurement of MIP (r=0.88 to r=0.92) in patients lying in a semirecumbent position. They reported a mean of 115 cmH2O on 10 healthy subjects; in our study, the mean MIP in sitting position with the portable CSPG-V was 82.82 cmH2O, which can be attributed to the positional differences. The semirecumbent position used by Maillard et al (11) would have led to an optimal length tension relationship of the inspiratory muscles, thereby facilitating stronger contraction of these muscles and, thus, greater MIP values.

Also, a study by Larson et al (14) tested the reliability of maximal inspiratory mouth pressures (PIMAX) by measuring PIMAX once per week for four weeks in 91 patients with COPD using an aneroid pressure gauge. They allowed five PIMAX trials at each test. From the first to the fourth test, the PIMAX increased by a mean of 9±10 cmH2O and from the third to the fourth test, PIMAX increased by a mean of 2 cmH2O and performance appeared to be plateauing. The test-retest reliability coefficient was 0.97 for MIPs measured at the third and fourth test sessions while the 95% CI for the absolute difference in PIMAX at the third and fourth test was 3 cmH2O to 5 cmH2O (14). Therefore, as the number of trials increased from the third to fourth test and above, there was a learning effect in which the MIP values plateaued beyond the third trial. To account for this, we had each participant perform three trials and the best of the three readings was considered for study purposes.

To determine whether reproducibility is a valid indicator of maximal effort in MIP, Aldrich and Spiro (8) measured inspiratory pressures 18 times each in 10 healthy adults (nine maximal efforts and nine submaximal efforts). They reported no clear separation between the coefficients of variation or ranges of maximal and submaximal efforts, concluding that reproducibility was not a clear indicator of a valid MIP test for research purposes, in which relatively small changes in inspiratory muscle strength must be discriminated; however, in a clinical setting, MIP testing using a portable device such as the CSPG-V is sufficiently reliable to make it a useful addition.

Limitations to the present study include the absence of maximum expiratory strength and body mass index measurements, which may have influenced the MIP values. Further studies should focus on validation of this device and to test its reliability in various respiratory disease populations.

Clinical implications of the CSPG-V device are that it can be used for patient assessment as well as training of inspiratory muscles in hospitals, home, community and also in typical clinical settings. This would provide better insight to improving dyspnea and the quality of life of these patients.

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**TABLE 1**

<table>
<thead>
<tr>
<th>Rater</th>
<th>Total, n</th>
<th>Maximum inspiratory pressure, cmH2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (day 1)</td>
<td>40</td>
<td>82.82±32.76</td>
</tr>
<tr>
<td>A2 (day 2)</td>
<td>40</td>
<td>82.43±32.785</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD unless otherwise indicated

**TABLE 2**

<table>
<thead>
<tr>
<th>Rater</th>
<th>Total, n</th>
<th>Maximum inspiratory pressure, cmH2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>74.48±24.916</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>72.94±22.441</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD unless otherwise indicated
REFERENCES


CONCLUSION

The hand-held portable device described in the present study is an acceptable and reproducible tool for assessing and treating patients with inspiratory muscle weakness. It is inexpensive and portable, which further enhances its use in typical clinical settings. Use of this device may lead to better patient care and management pertaining to known and unknown causes of dyspnea requiring inspiratory muscle training.

DISCLOSURES: The authors have no financial disclosures or conflicts of interest to declare.
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 conversion 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

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 caudal into the trachea. Dilation over the guidewire facilitates the ultimate insertion of the tracheostomy tube over an insertion/dilation guide.

The use of bronchoscopy (fiberoptic 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 fiberoptic 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.

Une série de cas unicentriques pour évaluer les trachéotomies percutanées par aScopeMC 2 d’AmbuMD : 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’aScopeMC 2 d’AmbuMD est un vidéoscope à usage unique sans sonde d’aspiration qui peut remplacer le BFS.

MÉTHODOLOGIE : La présente analyse est une série de cas unici- triques et prospectifs d’amélioration de la qualité remplaçant le BFS par l’aScopeMC 2 d’AmbuMD 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’aScopeMC 2 d’AmbuMD.

RÉSULTATS : L’aScopeMC 2 d’AmbuMD 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 remplissage 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’aScopeMC 2 d’AmbuMD 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.

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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.

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 DIP 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 reprocesing 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...
The 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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2015

May 21-24, Calgary, Alberta: Canadian Society of Respiratory Therapists Educational Conference and Trade Show. Contact the Canadian Society of Respiratory Therapists, Katherine Nollet, 201-2460 Lancaster Road, Ottawa, Ontario K1B 4S5. Telephone 613-731-3164, fax 613-521-4314, website www.csrt.com

June 4-5, Toronto, Ontario: Canadian Critical Care Review. Contact the Program Coordinator Louise Bruns. Telephone 519-699-9232, fax 519- 218-8919, e-mail brunslo@criticalcarereview.ca, website www.canadiancriticalcarereview.ca

June 6-10, Seattle, Washington: SLEEP 2015, the 29th Annual Meeting of the Associated Professional Sleep Societies. Contact the American Academy of Sleep Medicine, 2510 North Frontage Road, Darien, Illinois 60561, USA. Telephone 630-737-9700, fax 630-737-9790, e-mail sleepmeeting@apss.org, website www.sleepmeeting.org

June 7-9, Winnipeg, Manitoba: 69th Annual Meeting of the Canadian Society of Otolaryngology (CSO). Contact the CSO, Donna Humphrey, General Manager, 221 Millford Crescent, Elora, Ontario N0B 1S0. Telephone 519-846-0630, fax 519-846-9529, e-mail cso.hns@sympatico.ca, website www.ecfs.eu

June 10-13, Brussels, Belgium: 38th European Cystic Fibrosis Society Conference. Contact the European CF Society, Kastanieparken 7, Karup 7470, Belgium. Telephone 45-8667-6260, fax 45-8667-6290, e-mail info@ecfs.eu, website www.ecfs.eu

September 6-9, Denver, Colorado: 16th World Conference on Lung Cancer. Contact the International Association for the Study of Lung Cancer, 13200 East Colfax Avenue, Unit 10, Aurora, Colorado 80011, USA. Telephone 855-464-2752, fax 855-593-5477, e-mail pia.hirsch@iaslc.org, website www.iaslc.org
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LAMA: long-acting muscarinic antagonist; COPD: chronic obstructive pulmonary disease; LS: least square; SGRQ: St. George’s Respiratory Questionnaire, measures health-related quality of life in symptoms, activities and impact on daily life; FEV1: forced expiratory volume in 1 second.

† GLOW2: A 52-week, randomized, double-blind, placebo-controlled parallel-group study of 1,060 patients with COPD. Patients received either SEEBRI® BREEZHALER® (glycopyrronium 50 mcg o.d.; n=525), placebo (n=268), or open-label tiotropium (18 mcg o.d.; n=267) as an active control. Primary endpoint was 24-hour post-dose (trough) FEV1 following 12 weeks of treatment.

‡ GLOW1: A 26-week, randomized, double-blind, placebo-controlled parallel-group study to assess the efficacy, safety and tolerability of once-daily SEEBRI® BREEZHALER® (50 mcg) in patients with COPD (n=550); placebo (n=267).

§ LS mean FEV1 (L) after first dose; SEEBRI® BREEZHALER® (n=169) vs. placebo (n=83), respectively: 5 min: 1.39 vs. 1.30; 15 min: 1.43 vs. 1.38; 30 min: 1.46 vs. 1.38; 1 hr: 1.47 vs. 1.38; 2 hrs: 1.53 vs. 1.39; 3 hrs: 1.53 vs. 1.39; 4 hrs: 1.52 vs. 1.39; 6 hrs: 1.48 vs. 1.38; 8 hrs: 1.47 vs. 1.32; 10 hrs: 1.47 vs. 1.32; 12 hrs: 1.45 vs. 1.31; 23 hrs 15 min: 1.37 vs. 1.27; 23 hrs 45 min: 1.38 vs. 1.31; p<0.001 for all time points.

References:


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