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EDITORIAL

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Unplanned extubations: making progress using CQI

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Nearly 10% of all endotracheal (ET) tube removals in the Intensive Care Unit (ICU) are unplanned; roughly 90% being the result of deliberate removal by the patient and 10% due to accidental dislodgement [1, 2]. This unacceptably high incidence has not changed appreciably over the past two decades, despite repeated documentation of the problem and its potentially devastating consequences [1]. Dr. Chiang and colleagues [3] present convincing evidence that by applying straightforward, well-conceived changes to practice patterns, the incidence of unplanned extubation (UE) can be cut in half. Their work provides an important step in solving the problem and, in so doing, should serve as a impetus for clinicians to develop their own continuous quality improvement (CQI) programs. Important questions remain unanswered, however, which will require further investigation.

Chiang and co-workers [3] identified the major components of their CQI program as: 1) the standardization of procedures for securing endotracheal tubes, 2) encouragement of active communication between staff and patients, including preoperative education, to help manage discomfort and improve the patients' understanding of UE, 3) the development of guidelines for the use of sedatives, analgesics and psychotropic agents, 4) the standardization of the use of physical restraints, and 5) the avoidance of undue delay of elective extubation, similar to other recommendations [1]. Importantly, they organized a multi-disciplinary CQI task force, implemented educational courses and continuously assessed progress and problems. From the first to the third trimester of data collection they demonstrated an impressive reduction in incidence density from 2.6 to 1.2 UE/100 mechanical ventilator (MV) patient-days. Expressed in another way, the percent of all extubations due to UE fell from about 13% to 6%. Further, major complications, including deaths, were less common.

What components of the CQI program can be credited with this improvement? Improved ET tube stabilization is probably important. It is of interest that Chiang et al. [3] found virtually all of the improvement to occur in orally intubated patients. In the first trimester the incidence density was 4.6 cases/100 MV days, which translates to an extraordinarily high 20–25% UE rate. This fell steadily to 1.7 and 1.0 cases/100 MV days in subsequent trimesters. Chiang et al. [3] used twill tape to secure their ET tubes. Previous comparative studies have found twill tape to be similar to adhesive tape as far as tube movement, ease of use, and oral hygiene [4]. Accordingly, I suspect that the improvement is more likely the result of scrupulous attention to, and close monitoring of, the tube and securing device rather than the use of twill tape, per se. A variety of devices specifically designed for securing ET tubes have been manufactured and compared in clinical settings, with most devices being judged satisfactory but not clearly superior to conventional techniques [5, 6]. We generally reserve the use of these devices, which have added cost, to patients with beards, skin disorder or excessive oral secretions [1].

In contrast to orotracheal intubation, the UE incidence was remarkably stable and acceptably low (in the 1.4–1.2 cases/100 MV days range) for nasally intubated patients throughout the program [3]. Why not just routinely use nasotracheal placement? Whether nasally placed ET tubes are more secure and associated with reduced UE has been debated. Although some studies [7, 8] suggest that lower rates occur with nasotracheal tube placement, the only randomized prospective study comparing the two approaches found identical UE rates [9]. The highly variable UE rate

for oral ET tubes seen within Dr. Chiang's hospital suggests that such variability might also be found among various institutions and may account in part for the contrasting published results regarding oral ET as a UE risk factor. Nevertheless, the nasotracheal approach does offer theoretical advantages regarding UE risk. Transnasal ET tube placement allows positioning of the proximal third of the ET tube within a narrow space with little opportunity for lateral movement; this contrasts sharply with the relatively open oral cavity which allows more tube movement as well as the opportunity for an agitated patient to "tongue" the ET tube out. Further, nasal ET tubes can be readily secured and their presence does not interfere with mouth care. However, in comparison with orally placed ET tubes, nasotracheal tubes are associated with a substantially higher rate of maxillary sinusitis [9, 10], a condition associated with clinical sepsis as well as one predisposing to nosocomial pneumonia [10]. The choice of approach for an individual patient will probably depend upon clinician bias as well as patient characteristics. Dr. Chiang's results indicate that low UE rates for orotracheal tubes are achievable.

Dr. Chiang and colleagues strive to optimize patient acceptance of the ET tube and to control agitated behavior through improved patient and care-giver education and communication, as well as the standardized use of sedatives, analgesics, psychotropic agents and physical restraints [3]. More aggressive use of sedating medications, while reducing agitation and unwanted extubation, could delay weaning from MV and elective extubation. Thus, it is important to note that the duration of mechanical ventilation did not increase with the use of their CQI program. While the development of guidelines for the administration of these medications is clearly worthwhile, it is crucial to emphasize that agitated behavior in an intubated patient is often related to specific medical conditions, such as ET tube malposition, hypoxemia, electrolyte disorders, medication side effects, pain or infection [1]. The optimal management of these conditions requires timely recognition and specific treatment, rather than reflex upwards titration of the sedative medication dosage.

Self-extubation can be prevented in most cases through administering deep sedation and applying physical restraints. The routine use of these measurements in all intubated patients is not justified however, since delayed elective extubation and side effects (pressure sores and aspiration with sedation and worsened delirium with restraints [11]) could result. The identification of high risk patients to target for more aggressive preventative management would be useful. Assessment of "risk" addresses two separate issues: 1) the likelihood of deliberate ET tube removal and 2) the likelihood that loss of the artificial airway and/or mechanical ventilation would have serious consequences. The latter issue has intuitive answers: patients who require a high percentage of inspired oxygen or high levels of PEEP to maintain adequate oxygenation, those who require high levels of ventilatory support for adequate gas exchange, patients with therapeutic or physical paralysis of the respiratory muscles and those patients for whom re-intubation would be difficult are at high risk of having adverse sequelae from UE. Identifying the patient who is likely to remove their ET tube is less well established, although most such patients are confused, if not overtly agitated.

Agitation is quite common in the critical care setting. We have observed some degree of agitation in as many as half of the patient-shifts and overt agitation manifested by patient removal of a tube or catheter, or aggressive behavior toward a care-giver in nearly 10% of patient-shifts [12]. Only a few investigators [7, 13] have attempted to identify the risk factors for UE in case series comparing consecutive UE and electively extubated patients. Coppolo and May [7] found no identifiable risk factor for UE and Smith [13] identified prior UE as the only notable risk factor. Chiang et al. prospectively established high risk criteria, which included agitation and prior UE (increased risk *for* UE), as well as history or difficult intubations and FIO_2 more than 0.5 (increased risk *from* UE). Although they found a correlation between high risk and likelihood of re-intubation, they did not address the ability of the risk factors to identify the patient who is likely to self-extubate. The development of criteria for recognizing this group of patients is needed.

On average, nearly 40% of patients who have UE do not require re-intubation [1]. One implication of this finding is that these patients have determined that it is time for extubation before we clinicians have and, therefore, call for us to re-examine our weaning and extubation strategies [14]. The decisions regarding readiness to wean and ability to tolerate extubation can be complex [15]. Despite extensive investigation, the development, validation and widespread acceptance of predictive indices for weaning or extubation has proven elusive. The comparison of UE patients who remain extubated with those who require re-intubation offers an interesting "model" of readiness for extubation which is relatively free of clinician bias (i.e. the patient, not the clinician, decided to extubate). A composite of factors reflecting ventilation and gas exchange, as well as several aspects of medical stability (multiple organ dysfunction, tachycardia, altered mental status) best distinguished the two groups in one large series [14]. It is likely that a successful predictive tool to aid in timely elective extubation will incorporate respiratory as well as medical parameters. As noted by Chiang et al. [3] and others [1] the avoidance of undue delay of elective extubation is an important component of a program aimed at reducing UE. It is doubtful whether this contributed significantly to the reduced UE rate in this study, however, since their re-intubation rate over the course of the program was 50%.

Finally, Chiang et al.'s work confirms the potentially devastating consequences of UE including aspiration pneumonia and death [3]. Timely re-intubation of high risk patients probably helps to avoid additional serious complications of UE and they observed fewer complications as the

study progressed. Their high risk patients more frequently required re-intubation, particularly those who had multiple risk factors. Previously published criteria developed using stepwise logistic regression offers another, perhaps more robust, tool for predicting the likelihood of re-intubation [14].

Dr. Chiang and colleagues are to be congratulated on developing a well-conceived CQI program and demonstrating its effectiveness in reducing UE. Our charge is to apply their knowledge and techniques as well as to address the unanswered questions in order to improve the outcome of our intubated patients.

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