Skin Preparation Process for the Prevention of Skin Breakdown in Patients Who Are Intubated and Treated With RotoProne

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Introduction

Identification and prevention of pressure ulcers is a major area of interest for hospital clinicians and regulatory agencies. More importantly, Gorecki et al[1] completed a meta-synthesis of 31 articles investigating the impact of pressure ulcers on health-related quality of life among geriatric patients and reported that pressure ulcers substantially affect physical, social, psychological, and financial aspects of health-related quality of life. Given the emotional impact on hospitalized patients and recognizing that pressure ulcers are largely preventable, it is no surprise that attention on pressure ulcer prevention has increased. The National Pressure Ulcer Advisory Panel defines a pressure ulcer as "localized injury to the skin and/or underlying tissue, usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction."[2] The University Medical Center at Brackenridge Respiratory Care and Wound Ostomy Continence Nurse (WOCN) Collaborative Practice Team was formed to address problems relating to skin breakdown due to respiratory care devices in the adult intensive care unit (ICU). The mission of this team is the proactive identification of high-risk patients and the quick implementation of a new skin preparation process to minimize or alleviate skin pressure ulcers and breakdown. While performing bedside evaluations of respiratory care devices, we encountered such problems as erythema, breakdown, and pressure ulcers due to airway devices.

The case study and discussion will outline the impetus behind and development of skin protection practices specifically involving respiratory therapists within a large teaching hospital. The progression of events occurred within the ICU at University Medical Center at Brackenridge, a member of the Seton Family of Hospitals, Austin, Texas. The skin protection practices were developed, trialed, and initiated following outcomes associated with an intubated patient placed on the RotoProne Therapy System (Kinetic Concepts, San Antonio, Texas). The poor skin outcome in the initial case patient described below prompted a new process for managing intubated patients with and without the use of the RotoProne system. Briefly, the RotoProne Therapy System is a bed that is designed to place a patient with acute pulmonary complications such as acute lung injury and acute respiratory distress syndrome (ARDS) in the prone position and provide kinetic therapy, which is a slow, gentle, side-to-side rotation of the patient to an angle between 40–62 degrees. When strapped onto the RotoProne bed, the face of the patient rests in a plastic covered foam headgear and the torso and limbs are secured to the bed. When the bed is rotated and the patient is prone there is considerable pressure placed on the forehead and cheeks, as well as shear forces on the skin as the patient is being turned side-to-side. The RotoProne bed requires a coordinated effort by healthcare providers during assessment and treatment times. Although the care of this patient included the use of the RotoProne bed, this particular therapy is not the focus of this teaching case. We wish to describe the skin protection practices developed and implemented by a collaborative group of healthcare professionals, including respiratory therapists, following the initiation of RotoProne therapy. In addition, we briefly describe our practice changes for skin protection when considering respiratory care devices and pressure ulcer formation.

Case Summary

The case report patient was a 26-year-old obese, Hispanic female, who was admitted with cough, fever of

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38.9°C, body aches, and shortness of breath for 5 days. Her past medical history included childhood asthma, with a family history of diabetes mellitus, hypertension, heart disease, sleep apnea, and breast cancer. Her social history included no alcohol, tobacco, or illicit drug use. The patient was initially evaluated in the emergency room, with a heart rate of 122 beats/min, respiratory rate of 40 breaths/min, blood pressure of 108/68 mm Hg, oral temperature of 38.6°C, and S_{pO_2} 93% on room air. A venous blood gas sample was analyzed, demonstrating the following values: pH 7.41, P_{aCO_2} 46.1 mm Hg, P_{aO_2} 29.2 mm Hg, HCO_3 30.2 mEq/L, base excess 5.3 mEq/L, S_{aO_2} 75%, and a lactate of 1.22 mmol/L. The chest x-ray demonstrated extensive and somewhat irregular alveolar infiltrates present in both perihilar regions. Initial influenza antigen, acid-fast bacilli, sputum culture, *Legionella*, *Streptococcus pneumoniae*, and blood cultures were negative. She was transferred to the internal medicine floor to be treated empirically and symptomatically.

On admission day 2 the patient developed respiratory distress, with S_{pO_2} dropping to 83% on room air. The patient was placed on a 50% venturi mask with a subsequent arterial blood gas (ABG) revealing a pH 7.46, P_{aCO_2} 46 mm Hg, P_{aO_2} 54 mm Hg, HCO_3 30.2 mEq/L, base excess 5.7 mEq/L, and S_{aO_2} 90%. She was transferred to the intermediate care unit and placed on noninvasive ventilation with inspiratory pressure of 15 cm H_2O and expiratory pressure of 5 cm H_2O, and F_{IO_2} 0.80 to achieve an S_{pO_2} of 90%. Vital signs at this time were heart rate of 120 beats/min, respiratory rate of 44 breaths/min, blood pressure of 102/60 mm Hg, and oral temperature 39.6°C. Auscultation revealed bilateral crackles. Chest x-ray revealed diffuse bilateral infiltrates. An initial Braden score of 20 was recorded. All patients have skin care assessment upon admission per nursing using the Braden scale. The Braden scale is a summated rating system designed to predict the risk of developing a pressure ulcer.[3] A lower Braden score indicates an increased risk for pressure ulcer development (see the supplementary materials at http://www.rcjournal.com).[3]

On admission day 3 the patient was assessed by the Critical Response Team and found to have increasing shortness of breath and decreasing S_{pO_2} to 80% despite noninvasive ventilation and F_{IO_2} of 1.0. She was transferred to the ICU and diagnosed with respiratory failure secondary to community-acquired pneumonia and ARDS. The patient was intubated and placed on the ARDS Network protocol with volume controlled continuous mandatory ventilation mode, respiratory rate 28 breaths/min, tidal volume 6 mL/kg (280 mL), PEEP 18 cm H_2O, and F_{IO_2} 1.0. Initial ABG on the ventilator revealed pH 7.46, P_{aCO_2} 43.1 mm Hg, P_{aO_2} 58.6 mm Hg, HCO_3 30.0 mEq/L, base excess 5.5 mEq/L, and S_{aO_2} 91.7%. Despite increasing PEEP levels to 20 cm H_2O, the patient's oxygenation status continued to worsen. The admitting pulmonologist ordered the patient to be placed on the RotoProne bed, and the endotracheal tube (ETT) was secured with an AnchorFast device (Hollister, Libertyville, Illinois). Her weight was 117.8 kg, and a Braden score of 11 was recorded.

Table 1. Intubated RotoProne Patient With Intact Skin

1. Apply non-alcohol barrier wipe to the face
2. Apply adhesive solution as needed to secure a critical airway
3. Apply fabric adhesive tape
4. Apply Mepilex Transfer dressing on top of the tape covering cheeks and forehead
5. Notify nurse and wound ostomy continence nurse
6. Document in respiratory care notes: preventative skin care done, no breakdown observed

On RotoProne/intubation day 2 the patient was placed on nitric oxide at 20 ppm, due to further deterioration in oxygenation status. The patient remained unable to tolerate supine turns, demonstrated by immediate drops in S_{pO_2} to $< 80\%$. On RotoProne/intubation day 5, substantial deep tissue injury had occurred to the patient's bilateral cheeks, due to pressure exerted by the AnchorFast device contacting the headgear of the RotoProne bed. A subsequent Braden score of 7 was recorded for the patient. The patient remained on the RotoProne bed and intubated for 19 days. Subsequently, a tracheotomy was performed and wound care procedures continued until discharge. She was then followed by the out-patient wound clinic. The total cost for the wound care was in excess of $5,000.

Skin Protection Procedure for RotoProne Patients

Following the poor skin outcome to this patient, work began between Respiratory Care Skin Champions (respiratory therapists focused primarily on skin initiatives) and the WOCN to develop a new process to secure the airway as well as protect the skin and prevent or minimize any skin breakdown or pressure ulcer development. Tables 1 and 2 outline this process. A non-alcohol barrier wipe is used to protect the face and place a barrier between the skin and the adhesive substance. This barrier wipe prevents injury to the skin that occurs from tape removal. An adhesive substance is spread across the cheeks and upper lip to help secure a critical airway with standard adhesive tape. The Mepilex Transfer dressing (Mölnlycke Health Care, Göteborg, Sweden) is a soft, absorbent foam to be cut and placed on both sides of the patient's face and across the forehead. This dressing prevents shearing injury from occurring to the skin when the patient is placed in the headgear and RotoProne turning is initiated. The dressing also provides wicking of moisture that is integral to allow perspiration to evaporate and not remain on the skin. The Mepilex Lite dressing (Mölnlycke Health Care, Göteborg,

Table 2. Intubated RotoProne Patient With Open Wound/Draining Sores on Cheeks and Upper Lip

1. Apply non-alcohol based barrier wipe
2. Apply Mepilex Lite dressing directly on top of the wound, under the tape
3. Apply adhesive solution as needed to unaffected areas, to secure a critical airway
4. Apply fabric adhesive tape
5. Apply Mepilex Transfer dressing on top of the tape covering cheeks and forehead
6. Notify nurse and wound ostomy continence nurse
7. Document intervention in respiratory care notes

Fig. 1. Picture demonstrates the skin protection procedure for an intubated patient undergoing RotoProne therapy. Mepilex Transfer dressing is placed on the checks and forehead. White fabric adhesive tape secures the endotracheal tube.

Sweden) is the recommendation by the WOCN for the treatment of open wounds and draining sores on the face and upper lip. This dressing allows the open wound to be protected and promotes healing by keeping the wound bed moist. The AnchorFast device is not used to secure the airway while the patient is proning. White fabric adhesive tape is used to secure the airway because it can be applied with no wrinkles, seams, or excessive materials that can cause pressure to the patient's face (Fig. 1).

Discussion

Additional Skin Protection Procedures

As a way to track our efforts, we collected quality improvement data on all patients utilizing the RotoProne bed subsequent to the case report patient described above. Following the initiation of our trial process we recorded no hospital-acquired pressure ulcers to the face and lips of RotoProne patients. Review of University Medical Center at Brackenridge quality improvement data and success rates were shared with the Network S.K.I.N. (Surface, Keep Turning, Incontinence, Nutrition, copyright 2010, Ascension Health) Team. Due to the success of these recommendations, the skin protection procedure was accepted and spread across all 10 network hospitals, encompassing 1,200 beds and serving the central Texas region of 1.8 million people. In addition, the formation of a Respiratory Care S.K.I.N. Practice Group with representatives from all 10 Seton Family of Hospitals in the Austin area was formed to develop a standard of care for all skin care issues related to respiratory devices. A Wound Assessment and Wound Care section was developed and added to the hospital's electronic medical record. It was built to include respiratory care as a discipline able to manage wound assessment and wound care. Documentation in the electronic medical record is now a collaborative effort to include nursing, physical therapy, occupational therapy, Wound Ostomy Continence Nursing, and respiratory care. In addition, a specific section of the electronic medical record is designated to respiratory therapist charting and was built for the documentation of skin preventive care initiatives. This new assessment and documentation process represents "a critical step in advancing the efforts to improve wound care outcomes. . . . Outcome measurement provides a concrete context and feedback for quality improvement, and offers compelling evidence for increasing organizational efforts to improve wound care outcomes."[4] "Using a computerized documentation system and standardized interventions and outcomes will allow comparisons to be made at an individual unit level or at a system level."[5]

In addition to the skin initiatives for RotoProne patients, a respiratory care skin bundle was developed for all intubated patients. The skin bundle was presented to a collaborative group of practitioners, represented by WOCN, respiratory care, registered nurses, Seton Network Patient Safety Project management consultants, clinical quality, and the patient safety skin team. The skin bundle is a preventive care measure and consists of: re-taping the ETT every 24 hours, repositioning the ETT from side to side, oral care every 2 hours with an oral care kit, applying lip and mouth moisturizer, using ventilator support arms for circuits, and using AnchorFast device if applicable when the patient is supine. In addition, we do not tape any items (eg, nasogastric tube, small bore feeding tube) to the ETT.

Outcomes Data

Using the principles of the network S.K.I.N. Practice Group to prevent respiratory device related pressure ulcers, our team has been successful, with a substantial decrease in skin breakdown, using new methods to secure the devices, to rotate placement, and to initiate routine skin assessments by respiratory therapists. A network goal of

zero preventable pressure ulcers for all respiratory care devices has now been established. The University Medical Center at Brackenridge respiratory care device related pressure ulcer rate in the first quarter of 2008 prevalence data was 18%. Following an initial ETT and noninvasive ventilation skin preparation trial process in the first quarter of 2009, prevalence rates dropped to 10%. With the addition of the skin preparation process for intubated and Roto-Proning patients, our device related pressure ulcer rate has dropped to 0% and has maintained this percentage for 18 months. Compilation of data from August 2009 to February 2011 resulted in the bedside assessment, treatment, and quality improvement of 1,527 patients by the Respiratory Care Skin Champions in the ICU at University Medical Center at Brackenridge. Respiratory Care Skin Champions now make daily rounds in the ICU to evaluate the skin of patients with respiratory care devices, to evaluate wound progression, and to make changes in care. This information is entered into a tracking tool and used to assist the bedside respiratory therapist, WOCN and nurse with real-time evaluation and immediate modification of taping and securing methods for ETTs and evaluation of skin integrity of critical care patients. The respiratory therapists are now involved in a new area of patient care, resulting in greater staff satisfaction. "We have been able to help patients and relieve pain and suffering caused by preventable wounds. It has been very exciting." (personal communication, Julie Dostal RRT, University Medical Center at Brackenridge, April 2010). The success has improved the ICU team working relationships and prompted heightened sensitivity to skin issues.

Mechanical ventilation is a recognized risk factor for pressure ulcer formation.[6,7] However, there is a scarcity of literature focusing on the identification and prevention of pressure ulcers due to the ETT as well as RotoProne therapy. Our search of the literature as well as our own hospital network for "best practice" recommendations for pressure ulcer prevention yielded less than satisfying results. Therefore, we developed the procedures discussed above to serve as a "trial process" to prevent hospital-acquired pressure ulcer formation. Team collaboration was vital to the success of this skin initiative because, "…members will have different roles and responsibilities at different times, but respect and collaboration will be the hallmark of effective team functioning."[8] Finding new ways to help patients and to prevent suffering and painful disfigurement to the face has been very rewarding for our team. Senior hospital and network leadership are very supportive of this initiative and continue to recognize the benefit that it has to our patients and to our network outcomes. The research, collaboration, and development of standardized skin care processes related to respiratory care devices during this project are all valuable tools for clinicians to review and consider for implementation in their daily practice.

> The practice of respiratory care is evolving to meet the changing demands of the healthcare system, and these evolutionary processes will define the future respiratory therapist. A key challenge for all healthcare providers will be to continuously evaluate changes in clinical practice to ensure appropriate growth and development of their profession, as well as the delivery of appropriate services under new care management settings and processes.[9]

Teaching Points

We were able to completely change how respiratory therapists view skin issues among critically ill patients within a large network of hospitals. Although skin issues have not appeared in the traditional purview of respiratory therapy training, this area represents a new frontier for therapists and educators. Respiratory therapy curricula should include skin issues covering all patient categories (ie, neonatal, pediatric, and adult). It is important to remember that skin issues pertain not only to artificial airways but also to simple devices such as nasal cannula and noninvasive monitors. Lastly, maintaining skin integrity represents another important aspect to consider when deciding to place patients on the RotoProne Therapy system. If proper skin protection procedures are not implemented, patients may suffer iatrogenic pressure ulcer development similar to our case patient.

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