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Interface pressure redistribution on skin during continuous lateral rotation therapy: A feasibility study

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ABSTRACT

Background: Continuous Lateral Rotation Therapy (CLRT) is a therapy used in ICUs for early mobilization of ventilated patients. CLRT is believed by some in health care to not be sufficient to allow for capillary reperfusion, and may lead to tissue damage.
Objectives: To determine if there are differences in skin interface pressures, skin integrity, or perceived discomfort across three positioning scenarios.
Methods: A Hill-Rom Total Care SpOrt® bed was equipped with a pressure mapping device. Ten healthy volunteers were placed in each positioning scenario for 30 minutes; interface pressures were recorded.
Results: CLRT alone demonstrated statistically lower interface pressures on ischial tuberosities ($p < 0.05$) as compared to the scenarios with static wedge. Higher pressures were noted on the heels in CLRT alone ($p < 0.05$). One subject noted pain with CLRT. No erythema or breakdown noted.
Conclusions: This feasibility study supports the use of CLRT to decrease pressure on capillary beds and decrease patient discomfort.

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Introduction

Health care facilities are graded and financially reimbursed based on the outcomes of the patients they serve. Two of the outcome metrics reflective of nursing practice are Hospital Acquired Pressure Ulcers (HAPU) and Ventilator Associated Pneumonia (VAP) according to The Nursing Database of Nursing Quality Indicators (NDNQI). Hospital acquired pressure ulcers have a 4.77% incidence rate in critical care units while VAP has a reported incidence of 10–20% of all ventilated ICU patients and a mortality rate as high as 50–70%.[1,2] Both of these adverse events have both been associated with prolonged immobility in critical illness.[3] Although these have been considered independent conditions, Continuous Lateral Rotational Therapy (CLRT) has been cited as a method to reduce incidence of both HAPU and VAP in hospitalized patients.[3–7]

Continuous lateral rotation therapy refers to the continuous mechanical rotation of a patient on a lateral plane while in bed by the bed's mechanical system. The degree to which patients are rotated is dependent on the bed manufacturer and the patient condition; this will be described more in "Procedures." Originally termed by Dr. Francis Keane in 1967, health care professionals have utilized this therapy with the critically ill ventilated patient not only as a prophylactic measure against development of nosocomial pulmonary infections but also as an adjunct treatment for significant pulmonary dysfunction (i.e. Acute Lung Injury/Acute Respiratory Distress Syndrome). The effect of CLRT on pulmonary outcomes is well-known in the literature. Four studies from 1999 to 2012 demonstrate a statistically significant decrease in VAP rates when CLRT was implemented as compared to patients who were manually repositioned.[4–7] Early implementation of CLRT (within 1 hour of positive end expiratory pressure requirement > 8 cm H_2O, or $FiO_2 > 0.5$) decreased ICU length of stay and overall cost ($p = 0.04$).[7,8] The literature is vague in terms of identifying the most effective CLRT standards to achieve pulmonary benefit. Many sources encourage the use of CLRT for

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18 hours per day using a 51–144° total arc. Note again this range of rotation arc is due to bed manufacturer variability and patient condition. This variability in how CLRT is used indicates the need for standardization in therapy protocol.[9]

While the benefit of CLRT on pulmonary outcomes is recognized in the literature, the effect of CLRT on a patient's skin integrity is not well understood. This continuous high-degree rotation therapy without manual repositioning is anecdotally thought to be, by some in the health care community, injurious to the immobile patient's skin/tissue integrity. This is due to the presumption that pressure redistribution on CLRT is not adequate to allow for capillary reperfusion, a physiologic mechanism required to prevent tissue breakdown.[3] According to Landis, arterial capillary occlusion pressure is approximately 32 mm Hg.[10] Therefore, an external pressure exerted against a capillary bed greater than 32 mm Hg is thought to occlude blood flow. Under-perfused tissue is at risk for breakdown, infection, and necrosis. In addition, prolonged hypoperfusion leads to capillary leak syndrome, especially in conjunction with hypoalbuminemia, edema, and increased pressure on vasculature. Sudden reperfusion of an under perfused area has also been thought to cause a free radical induced inflammatory response leading to further tissue breakdown.[11]

Anecdotally, CLRT has been thought of as an inadequate therapy for pressure redistribution. However, there are reports in the literature of improved skin protection when CLRT is used. Simonis showed a decreased incidence of pressure ulcers with CLRT as compared to manual positioning; Anderson and Rappl illustrate the potential healing effects on established pressure ulcers that CLRT may provide.[5,12] The anecdotal belief that CLRT can cause HAPUs has led some institutions to incorporate required manual repositioning every 2 hours into their CLRT protocols. Manual repositioning by staff, usually with pillows, is thought to better redistribute pressure. This anecdotal belief may be supporting individual institutions to build in "breaks" into the CLRT protocols because the providers may not feel that CLRT is adequate for pressure redistribution.

Pressure mapping technology has been used to quantify the amount of pressure exerted on the capillary beds and therefore illustrates the effectiveness of pressure redistribution techniques. Behrendt describes how the use of bedside pressure mapping technology to guide the frequency and degree of turning decreased the rate of HAPU to 0.9% in the study group compared to 4.8% in the control group.[13] A graphic display provides the bedside caregiver the ability to localize the area of increased pressure and readjust the patient appropriately to relieve pressure.

To fully utilize the documented pulmonary benefits of CLRT, research must be conducted to address concerns about the effects of CLRT on skin integrity. One limited study examined this effect; however, the small sample size and poor methodological quality limits the usefulness of the results.[14] The purpose of this feasibility study was to examine the effect of CLRT on posterior skin integrity as compared to static manual positioning in healthy participants as a first study leading to future research examining CLRT effects on the skin of critically ill patients. This is among the first studies of this method to evaluate the effects of CLRT on skin integrity; we chose to use healthy adults in this first study to evaluate the accuracy of data we would record and to serve as a foundation for future research.

Research questions

Are there differences in skin interface pressure readings, skin integrity, or perceived discomfort among three positioning scenarios: CLRT only; CLRT with static manual wedge; and static manual wedge? (Box 1, Fig. 1)

Box 1. Positioning scenarios

1. CLRT at 40°, 30-s pause L-C-R, no training
2. CLRT at 40°, 30-s pause L-C-R, no training; static manual wedge (40°) positioning to the left.
3. Static manual wedge (40°) positioning to the left. No CLRT.

Methods

Study design and sample

This repeated measures feasibility study, in which participants were used as their own control, was conducted in the Nursing Clinical Education Center of a large academic tertiary medical center in July 2013. A call for healthy participants was posted on the institution's research website and internal newspaper. Healthy participants were used in this feasibility study as this study was conducted to test the study protocol and provide bedrock data for future replication of the study with critical care patients. Exclusion criteria included conditions of diabetes mellitus or peripheral vascular disease, age >65, and current continuous use of NSAIDs. These exclusion criteria were used because these factors are known to increase the likelihood for pressure ulcer development. Individuals under 18 years of age or with chronic skin/tissue breakdown or current pressure ulcers were also excluded; such exclusion criteria may be modified in future research based on the patient population studied. Compensation was available for the participants through a grant from the institution's Nursing Research and Evidence-Based Practice Committee.

Ten participants were enrolled, 4 male and 6 female. The ages ranged from 18 to 63 with BMI ranging from 20.3 to 48.9 (Table 1).

Measurements

A research assistant was trained by a licensed Wound Ostomy Continence nurse to perform posterior skin assessments. Online

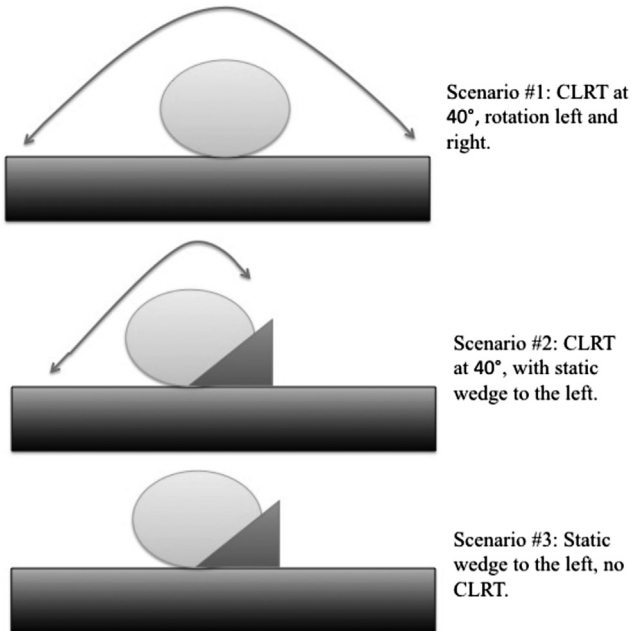

Fig. 1. Scenario schematic.