

Continuous Lateral Rotation Therapy Via Mattress Replacement in a Critical Care Setting

Submitted by:

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Introduction

In today's health care environment, hospitals are charged with caring for higher acuity patients whose treatment often involves invasive procedures, such as mechanical ventilation. Hospital acquired pneumonia remains the leading cause of death from infection, and is the leading cause of morbidity/mortality in the Intensive Care Unit (ICU).¹ Further, according to a recent Society of Critical Care Medicine press release, in the next 20 years the aging baby boomers will collectively make a "record number of visits to the ICUs."² This, combined with a nursing population that is both shrinking and getting older, leads institutions to seek out more effective ways to deliver optimal patient care safely and efficiently.

Continuous Lateral Rotation Therapy (CLRT) delivered via framed products has been shown to decrease the incidence of nosocomial pneumonia, ICU length of stay (LOS), and number of ventilator days by varying degrees.³⁻⁵ However, no study to date has investigated the benefits of CLRT delivered by a mattress replacement.

At Sarasota Memorial Healthcare System, the number of ventilator days in the ICU decreased due to implementation of the Ventilator Care Track, but had reached a plateau. Examination of APACHE data revealed that the predicted mortality was less than the observed mortality for patients admitted with a pulmonary diagnosis. As a result, a process improvement initiative, focused on further improving the outcomes of patients admitted to the ICU, was initiated. The purpose of this study was to determine whether the use of a CLRT placement protocol would decrease morbidity and mortality, ventilator days, and/or ICU LOS in patients with a pulmonary

diagnosis. The study also attempted to discern the difference in ventilator days, ICU LOS, and hospital LOS based on time elapsed from identification of subjects to initiation of CLRT via mattress replacement.

Materials and Methods

The study was conducted in the 32-bed Medical/Surgical ICU of Sarasota Memorial Health Care System, an 850-bed Level II Trauma Center located in Sarasota, Florida. Patients who met established criteria received CLRT via the V-CUE[®] Dynamic Air Therapy[®] Unit manufactured by Hill-Rom (marketed under the trade name Respistar in Europe). Criteria for inclusion into the CLRT protocol included presence of mechanical ventilation, delivered $\text{FiO}_2 > .50$, and $\text{PaO}_2/\text{FiO}_2$ ratio (P/F) < 300 . Twenty-three patients who met inclusion criteria entered an established CLRT protocol that included placement on the V-CUE[®] unit within 24 hours. Subjects began rotation in training mode, and rotated with minimum pause times for at least 18 hours per day. Percussion and/or vibration were instituted per protocol on patients with heavy respiratory secretions and/or atelectasis reported on chest x-ray.

The study was conducted over a three-month period from January through March 2001, using the APACHE III system for patient data interface, data collection and repository. APACHE III is a computer-based clinical decision support/outcomes management tool and severity-adjusted disease

classification system. It serves as an analytical tool that provides severity risk-adjusted comparisons of LOS, mortality risk, monitoring level, and need for treatment. The APACHE III scoring parameter Standardized Mortality Rate (SMR) was used to evaluate mortality. The mortality rate was risk-adjusted by using the APACHE III equation, $SMR = \text{observed mortality} / \text{predicted mortality}$, to provide a performance indicator ratio.

Once the CLRT protocol was complete, staff education and training was implemented using pulmonary system modules that focused on pulmonary physiology, function, disease, and research reflecting the benefits of aggressive pulmonary hygiene as part of a treatment plan. Nurses, respiratory therapists and patient care assistants were trained on proper operation of Hill-Rom's V-CUE® specialty bed. In order to ensure protocol compliance, both the CNS and clinical coordinator completed daily rounds. Additionally, protocols were included in the computerized medical information system and posted in the staff lounges.

For comparison purposes, a randomized retrospective control group of 23 subjects was selected (every other patient who met study criteria) from patients admitted to the Medical/Surgical ICU with a pulmonary diagnosis between January and March 2000. Subjects in this group met inclusion criteria described above, but did not enter an established CLRT protocol. Descriptive statistics were compiled in order to compare the CLRT group with the retrospective group who did not receive CLRT.

Additionally, a randomized subgroup of patients was selected to evaluate the impact of therapy lag time on clinical outcomes. Twenty patients who were placed on CLRT < 5 days after meeting established criteria were compared to 14 patients who were placed on CLRT ≥ 5 days after meeting the same criteria, to detect differences in ventilator days, ICU LOS, and hospital LOS related to therapy lag time. Support for statistical analysis of the data was provided by Hill-Rom.

Results

Descriptive data regarding subjects is shown in Table 1. There was no significant difference in age between patients in the two groups. However, patients in the CLRT group exhibited significantly higher acuity levels than the control group, as demonstrated by Acute Physiology Scores (APS), predicted death rates, and mortality ratios.

Table 1 – Descriptive Data of Patient Populations

	Retrospective Non-CLRT n = 23	CLRT n = 23
Mean Age (Range)	64 (34 - 83)	69 (38 - 83)
Avg Acute Physiology Score (APS)	58.2	65.76
Day 1 Predicted Mortality	0.32	0.49
Observed Mortality Ratio	0.39	0.48

Outcome measures based on comparison of the CLRT and retrospective control groups are listed in Table 2. Even though the CLRT group contained significantly higher-acuity patients, this group demonstrated a 14% decrease in ventilator days, compared with the retrospective control group. ICU LOS did not differ significantly between the two groups, perhaps owing to the higher acuity patient population comprising the CLRT group, but hospital LOS improved by 14% in the study group. The CLRT group also experienced a 20% decrease in Standard Mortality Rate as compared with the group who did not receive CLRT.

Table 2 – Comparison of Outcome Measures

	Retrospective Non-CLRT n = 23	CLRT n = 23
Avg Acute Physiology Score (APS)	58.2	65.76
Ventilator Days (avg)	13.39	11.57
ICU LOS (avg)	15.43	15.44
Hospital LOS (avg)	26.61	22.96
Standardized Mortality Ratio (SMR) <small>SMR = Observed / Predicted Mortality</small>	1.22	0.98

Results of the ANOVA statistical analysis comparing lag times are reported in Table 3. The two CLRT groups did not differ significantly with regard to acuity, as measured by APS. Both ICU LOS and ventilator days were significantly lower ($p < 0.01$) in those patients who met CLRT protocol inclusion criteria, and were placed on CLRT within 5 days, compared with those patients who were placed on CLRT ≥ 5 .

Although the decrease in hospital LOS did not reach statistical significance, mean hospital LOS was reduced by 29% when patients were placed on CLRT within five days of meeting inclusion criteria. SMR was also reduced by 42% when patients were placed on CLRT fewer than five days after meeting CLRT protocol inclusion criteria.

Table 3 – Lag Time Comparison

	CLRT Lag Time ≥ 5 days n = 14	CLRT Lag Time < 5 days n = 20	F statistic	p value
Acute Physiology Score (APS)	66.98	65.17	0.52	0.233
Ventilator Days (avg)	23.43	11.5	3.84	0.008
ICU LOS (avg)	27.86	14.65	4.68	0.003
Hospital LOS (avg)	31.5	22.5	1.89	0.202
Standardized Mortality Ratio (SMR)	1.71	1.0		

Retrospective comparison analysis of the last two years' APACHE data is shown in Table 4. The data reveal further improvement in outcomes relative to all mechanically ventilated, critical care patients. Data from 2001 reflects outcomes in all critical care units, with the implementation of the CLRT protocol only in the Medical-Surgical ICU. 2002 data reflects outcomes in all critical care units with expansion of the CLRT protocol into the remaining critical care units (Open Heart Recovery and Cardiac Intensive Care).

Table 4 – Comparison of Pre-and Post-Intervention Outcome Measures

	2001	2002
Observed Ventilator Days (avg)	2.61	2.53
Predicted Ventilator Days (avg)	2.98	3.1
Ventilator Days Ratio Ratio = Observed / Predicted	0.88	0.82

Discussion

The results of this process improvement initiative study support the findings reported in the medical literature surrounding CLRT with regard to improved patient outcomes, including reductions in ventilator days, ICU LOS, and hospital LOS, even though patients in the CLRT group demonstrated significantly higher acuity levels. These findings are significant given that no other study has been published to date using CLRT delivered via mattress replacement.

Because patients demonstrated significant decreases in both ventilator days and ICU LOS when lag time was less than five days, it is important to identify patients for whom CLRT is indicated early on via an established protocol. As a result of the significant improvement in patient outcomes that occurred using the CLRT protocol, the critical care staff and physicians incorporated the protocols into the routine care of all mechanically ventilated patients.

Further research should be aimed at studying larger patient populations, as well as other disease processes for which CLRT is indicated.

References

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