Kubo, A.
Self Directed Study
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Progressive Mobility™ Therapy in the ICU

Continuous Lateral Rotation Therapy (CLRT)
Progressive Upright Mobility (PUM)

April 2008

INSTRUCTIONS:

1. This is a self-directed study (SDS) to help guide your understanding of the purpose of Progressive Mobility in the ICU and how to implement the Standards of Practice & Procedures.

2. Refer to the following documents, included in this packet:
   - Continuous Lateral Rotation Therapy SOP
   - Progressive Upright Mobility SOP
   - Progressive Mobility Algorithm

3. Take the SDS Quiz.

OBJECTIVES/TABLE OF CONTENTS

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ALI/ARDS

BACKGROUND

In 1967 Ashbaugh and colleagues published a case series in the Lancet which described a clinical syndrome, which they (later) termed "Adult Respiratory Distress Syndrome" (ARDS). The 12 patients involved exhibited acute respiratory distress, cyanosis refractory to oxygen therapy, decreased lung compliance and diffuse pulmonary infiltrates on chest x-ray. Trauma doctors involved in treating victims of war had long been familiar with this syndrome, which came to be known as "wet lung", "shock lung" or "Da-nang lung". This problem had been identified during World War II but with the advent of advanced trauma (M.A.S.H. units during the Vietnam War) the prevalence of this form of respiratory failure was truly recognized.

Over the past 30 or so years, this syndrome has come to be one of the central problems of intensive care: lung injury arising from a variety of different etiologies, each characterized by bilateral diffuse infiltrates on x-ray, hypoxemia, and non-cardiogenic pulmonary edema.

CHARACTERISTICS

As stated above, ALI is a diffuse heterogeneous lung injury characterized by hypoxemia, non-cardiogenic pulmonary edema, low lung compliance and widespread capillary leakage. The severest form of ALI is ARDS. ARDS is the most intense form of hypoxemic respiratory failure.

Despite 20 years of research and advances in medical technology, ARDS mortality continues to remain greater than 50%.

CAUSES

ALI is caused by any stimulus of local or systemic inflammation by direct or non-direct pulmonary insults. Examples of causes include: DIC, fat embolus, drug reactions, burns, sepsis, aspiration pneumonia, major trauma, pancreatitis, multiple blood transfusion, radiation therapy, etc. to name a few.

CLINICAL DEFINITION

ARDS is a syndrome and not a specific pathophysiologic disease; therefore, patients are diagnosed with ALI/ARDS when they meet specific diagnostic criteria. There has been a challenge in determining the precise definition of and diagnostic criteria. In 1994, the American-European Consensus Conference (AECC) proposed a new definition of ARDS to bring clarity and uniformity to its definition. It is the AECC's definitions of ALI/ARDS that are uniformly accepted and recognized in current clinical practice. See Table 1, taken from Taylor (2005) for the clinical definitions of ALI and ARDS.

Table 1 Clinical Definition of Acute Lung Injury and Acute Respiratory Distress Syndrome

	ALI	ARDS
Timing	Acute onset	Acute onset
Chest radiograph findings	Bilateral infiltrates on frontal chest radiograph film	Bilateral infiltrates on frontal chest radiograph film
PCWP	<18 mm Hg and/or no clinical evidence of left atrial hypertension (CHF)	<18 mm Hg and/or no clinical evidence of left atrial hypertension (CHF)
PaO_2/FiO_2 ratio regardless of PEEP level	≤300 mm Hg	≤200 mm Hg

P/F RATIO

P/F ratio is the ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen. The PaO_2 is measured in mmHg and the FiO_2 is expressed as a decimal between 0.21 and 1.00. The normal P/F ratio is >500. Lower P/F ratios signify worse lung functioning and may be indicative of hypoxemia, which is one of the characteristics of ALI/ARDS. (See calculation example under "Documentation" page 6.)

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NORMAL GAS EXCHANGE

To understand ALI/ARDS, it is helpful to understand how your lungs work. A slice of normal lung looks like a pink sponge — filled with tiny "bubbles", known as alveolus. Around each alveolus is a fine network of tiny blood vessels. The alveoli, surrounded by blood vessels, give the lungs a large surface to exchange oxygen and carbon dioxide. This process is called gas exchange. Gas exchange occurs across this alveolocapillary (AC) membrane by diffusion.

It is essential that the lung stay "dry" and the fluid stays in the capillary for effective gas exchange. There are basically four factors that maintain a physiologic balance in order to keep the lungs "dry" and prevent the capillary fluid from crossing the AC membrane:

1. The capillary hydrostatic pressure - mechanical force of fluid pushing against cellular membranes (i.e. blood pressure)
2. The capillary oncotic pressure - overall osmotic effect in the capillary which tends to pull or keep fluid in the capillary
3. Capillary permeability
4. Surfactant lining the alveoli also repel water, keeping fluid from entering the alveoli

Gas exchange in the alveoli.

PATHOPHYSIOLOGY

The AC membrane is formed by 2 separate barriers — the vascular endothelium and the alveolar epithelium. Diffuse, non-uniform structural damage to the AC membrane remains the hallmark pathophysiologic consequence of ARDS. All disorders causing ARDS acutely injure the AC membrane and produce severe pulmonary edema, shunting, and hypoxemia.

Whether the damage occurs directly (i.e. aspiration pneumonia) or indirectly (chemical mediators released in response to systemic disorder), the common pathway for AC membrane injury is a massive inflammatory response by the lungs. In ARDS, the inflammatory response and subsequent mediator release is amplified.

The chemical mediators in the inflammatory response damage the AC membrane, greatly increasing the capillary membrane permeability. This allows fluids, proteins, and blood cells to leak from the capillary bed into the alveoli, resulting in pulmonary edema.

The chemical mediators and pulmonary edema also damage the alveolar epithelium which normally produces surfactant. Without surfactant alveoli collapse; causing atelectasis. The lungs become less compliant, ventilation decreases due to atelectasis, and this results in right-to-left shunting (see note below). Blood returns to the left heart without adequate oxygen, causing hypoxemia.

SHUNTING & DEADSPACE

When there is adequate perfusion/blood flow but no ventilation due to blocked alveoli or atelectasis, it is called shunting. When there is adequate ventilation with normal alveoli, but inadequate blood flow to the alveoli, it is called deadspace.

Understanding the pathogenesis of ALI/ARDS is the foundation on which continuous lateral rotation therapy is based upon.

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Continuous Lateral Rotation Therapy (CLRT)

Continuous Lateral Rotation Therapy is a method of positioning patients by using a programmable bed that turns, intermittently or continuously, with the aim of preventing and/or treating respiratory complications in critically ill patients.

CLRT is hypothesized to (1) improve drainage of secretions within the lung and lower airways (2) maximize functional residual capacity to minimize inflation pressure required to reopen lungs (3) reduce respiratory complications (VAP, atelectasis, ARDS) (4) reduce the risk of venous thrombosis and associated PE from immobility.

PROBLEM WITH STATIC POSITIONING AND MECHANICAL VENTILATION

When a patient is left in a static position, whether it be supine, left lateral, or right lateral position; the mucus, exudate, and capillary leak products pool in the dependent portions of the lung. For example, if a patient is placed in a left lateral position with HOB at 30 degrees, there will be accumulation and consolidation in the left lower lobe. This consolidation can cause complete or partial closure of the alveoli if not mobilized.

In addition, in a mechanically ventilated patient, the diaphragm loses its muscle tension and the abdominal contents move into the lung space, decreasing the overall functional residual capacity (FRC) — the amount of gas remaining in the lung at end of passive expiration. When FRC is reduced, lung compliance is decreased, requiring a higher level of pressure to re-open the alveoli.

The combination of consolidation and decreased FRC results in collapsed alveoli. Once the alveoli have collapsed, it is very difficult to restore patency of the alveoli.

HOW DOES CLRT WORK?

It is easier to prevent atelectasis and maintain adequate FRC than to try and restore patency of the alveoli. CLRT helps reduce atelectasis by continuously moving one lung over the other to mobilize secretions, which decreases the chance for the alveoli to close.

CLRT also improves gas exchange by placing the "good" lung in a [dependent] position for optimal gas exchange. Blood flow and gas distribution is affected by gravity. By placing the "good" lung in a dependent position, more blood flows to alveoli that are capable of optimum gas exchange; thus, improving oxygenation.

The movement from side to side maintains a higher FRC in mechanically ventilated patients in order to maintain the lowest pressure necessary to open the alveoli.

CLRT: EVIDENCE BASED LITERATURE

Davis (2001). The acute effects of body position strategies and respiratory therapy in paralyzed patients with acute lung injury. Critical Care, 5, 81-87.

- Studied 19 sedated, paralyzed, mechanically ventilated patients with ARDS.
- Found secretion clearance was enhanced by CLRT.

Kirschenbaum (2002). Effect of continuous lateral rotation therapy on the prevalence of ventilator-associated pneumonia in patients requiring long-term ventilatory care. Critical Care Medicine, 30(9), 1983-1986.

- 37 patients in the ICU, vent-dependent.
- Experimental group assigned to Hill-Rom beds.
- 17.6% of the experimental group on CLRT developed pneumonia; as opposed to 50% of the control group who did not have lateral rotation.

Ahrens et al (2004). Effect of kinetic therapy on pulmonary complications. AJCC, 13(5), 376-383.

- Study included 255 patients with P/F ratio <250; GCS<11; and mechanically ventilated.
- Found VAP and atelectasis were markedly reduced within 5 days and P/F ratio improved by the 2nd day.

Raoof et al (1999). Effect of combined kinetic therapy and percussion therapy on the resolution of atelectasis in critically ill patients. Chest, 115, 1658-1666.

- 24 MICU patients with atelectasis were assigned to either manual re-positioning every 2 hours or rotation therapy.
- 82.3% with continuous lateral rotation therapy had resolution of atelectasis, versus only 14.3% in the control group with manual turning.

Goldhill (2007). Rotational bed therapy to prevent and treat respiratory complications: A review and meta-analysis, AJCC, 16(1), 50-61.

- Meta-analysis of 35 studies between 1987 and 2004.
- Found that rotational therapy decreased incidence of pneumonia but had no effect on duration of mechanical ventilation, number of days in the ICU, or hospital mortality
- Concluded that rotational therapy is useful for preventing and treating respiratory complications, but inconclusive on which rotation parameters are the most effective.

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CLRT: Standard of Practice

Refer to the copy of the Unit Specific Standards titled "Continuous Lateral Rotation Therapy (CLRT)" attached to the end of this packet

ASSESSMENT & INITIATION CRITERIA

(Review the Standards for Assessment and Initiation Criteria)

Critical Care utilizes 2 types of rotation beds, depending on the patient's weight/girth.

If patient meets criteria for initiating CLRT, obtain a physician order for the appropriate lateral rotation bed. It is important to obtain a physician order for reimbursement purposes.

1. Hill-Rom® TotalCare SpO_2RT® system: provides rotation and percussion/vibration for patients of regular size
2. Hill-Rom® Bariatric Plus: provides rotation and percussion/vibration for patients with wider girths or [weight] up to 500 pounds

ROTATION GOALS

(Review the Standards for Rotation Goals)

These goals are meant to maximize optimal pulmonary outcome. Remember to assess patient for 2 complete rotations after initiation or change in rotation parameters. Allow a 5 to 10 minute equilibration period before determining hemodynamic instability.

ADJUSTING TO THERAPY INTOLERANCE

If the patient is not tolerating the rotation therapy by exhibiting signs of agitation, desaturation, hemodynamic instability, etc. we need to find a way to continue with rotational therapy that is more tolerable to the patient. Do not automatically turn off the rotation function until you have attempted to adjust therapy in the following manner:

1. First, try increasing the pause times before attempting to decrease rotation %
2. If the pause times do not work, try decreasing the % of rotation, or
3. Use the "Training" mode for gradual increases (increases rotation by 10% every hour)
4. Make sure patient is adequately sedated
5. Reassure and educate the patient

SKIN ASSESSMENT WHILE ON ROTATION

While on CLRT, skin assessment is still required every 2 hours. Rotation therapy is not a substitute for off-loading pressure areas. There is no evidence that rotation therapy helps relieve pressure. To inspect the skin and address pressure relief, do the following:

1. Every 2 hours, temporarily stop rotation.
2. Turn and inspect the posterior surface of the patient and all at-risk areas such as the occiput, elbows, and heels.
3. If pressure relief is indicated, offload the area with a positioning device, such as the wedge for as long as necessary to allow for circulatory recovery.
4. When ready to re-start rotation, remove the wedge or positioning device. Wedges are not to be used during rotation.

The timeframe for off-loading is purposefully not specified in the standards. You will need to utilize your nursing judgment to determine how long to off-load pressure areas by taking into consideration that the rotation cannot be turned off for more than 6 hours out of a 24 hour period.

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EVALUATION/RESPONSE TO TREATMENT

Patient response to CLRT is assessed by measuring ABGs, calculating the P/F ratio when ABGs are available, and a thorough pulmonary assessment, such as lung sounds, work of breathing, respiratory rate, etc.

P/F RATIO CALCULATION

Obtain the PaO_2 value from an ABG. Divide this value by the FiO_2 decimal value from 0.21 to 1.00. For example, a PaO_2 of 70 with an FiO_2 of 50% = 70/0.50 = 140. Remember a P/F ratio <300 represents criteria for CLRT initiation.

DISCONTINUATION CRITERIA

(Review the Standards for Discontinuation Criteria)

DOCUMENTATION

There are several places to document CLRT.

1. Document rotation therapy in the CLRT section of the flowsheet. The documentation should occur with initial assessment and at midnight. Therefore, the night shift will document in this area twice, while the day shift will document once.
2. Document the % rotation (left, right), pause times for center, left, and right. In the "Hours of Rotation", record the # of hours in rotation since midnight (this is how the bed records the number of hours).
3. Document narratives in the Nursing Notes when appropriate, such as: (1) date/time of CLRT initiation and criteria met (2) patient tolerance (3) adjustment to therapy/interventions (4) rationale for any periods in which rotation was stopped in excess of 6 hours/24 hours (5) Date/time CLRT discontinued, including criteria met.
4. Show in the "Activity/Position" section of the flowsheet that the patient continues to be turned and pressure off-loaded every 2 hours.
5. If an ABG is available, make sure to calculate the P/F ratio and record this number in the lab section.

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Hill-Rom® Bed Functions for CLRT

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PATIENT POSITIONING

To ensure that the patient is properly placed on the bed prior to initiating CLRT, make sure to do the following:

1. Remove the pillow from behind the head as the bed has a 'built-in pillow' for occipital pressure relief.*
2. Position the patient in the center of the bed.
3. Align the patient's shoulders with the "lung" landmark located on the upper siderails for optimal rotation position (do not align the hips with the "Hip" landmark).
4. Verify that the HOB is no greater than 40 degrees as the rotation function will not operate for HOB greater than 40 degrees.
5. Position the tubes, catheters, and equipment with enough slack to accommodate movement from side to side and prevent accidental dislodgment.

*The upper cushions around the head do not rotate.

PROGRAM SETTINGS

1. Activate the Graphical Caregiver Interface (GCI)® function by selecting "Rotation/Perc/Vib" from any (Main or Home) menu, Press ENTER.
2. From the Pulmonary Therapy Menu, there are 2 options. Select "Change Settings", ENTER twice.
3. Highlight "Rotation Therapy", Press ENTER twice.
4. Use up/down arrows to enter settings.
5. Press ENTER until all settings have been adjusted.
6. Select "Accept Changes", Press ENTER.
7. Select "Start Rotation", Press ENTER.

THERAPY STATISTICS SCREEN

You will utilize the Therapy Statistics Screen to record the total number of hours in rotation since midnight on the back of the flowsheet in the "CLRT Therapy" box. The history is stored for up to 7 days. To access this information:

1. Activate the Graphical Caregiver Interface (GCI)® function by selecting "Rotation/Perc/Vib" from any menu, Press ENTER.
2. From Pulmonary Therapy menu, select "Statistics", Press ENTER.
3. Select "Rotation Summary", press ENTER.
4. The most recent total number of hours in rotation since midnight is listed as Hours: Minutes.

POSITIONS/FEATURES THAT STOP ROTATION

If your bed is in one of these positions, the rotation will stop and alarm. Respond to the alarm, correct the problem, and **remember to resume rotation as soon as feasible** to maintain the minimum 18 hours/day rotation.

1. HOB > 40 degrees
2. Foot of bed lowered > 30 degrees in Chair Position
3. Siderail down
4. "Turn Assist" feature
5. "Max Inflate" feature
6. "Opti-Rest" feature

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Progressive Upright Mobility (PUM)

DEFINITION

Systematic progression of early ambulation for the purpose of enhancing functional capacity of the individual to withstand the stressor of inactivity associated with an ICU admission.

HAZARDS OF IMMOBILITY

There are numerous hazards associated with bedrest and immobility. See list taken from Goldhill (2007). AJCC.

Table 1 Hazards of Immobility

System	Complication
Respiratory	Pneumonia, atelectasis, pulmonary embolism
Cardiovascular	Postural hypotension, cardiac muscle atrophy, deep vein thrombosis
Skin	Pressure ulcers
Renal	Calculi, nephritis
Hematological	Anemia
Gastrointestinal	Constipation and fecal impaction
Metabolic	Glucose intolerance, negative nitrogen balance
Musculoskeletal	Osteoporosis, muscle atrophy, contractures
Neurological	Depression, psychosis

PURPOSE OF PUM

It makes sense that prolonged bedrest causes musculoskeletal deconditioning. Skeletal muscles atrophy with loss in contractility and strength. There is a 1 to 1.5% decline in strength per day with bedrest. The muscle groups that lose strength most quickly due to bedrest are the groups involved with transferring position and ambulation. It is known that deleterious effects of bed rest can be reduced or prevented through various types of physical activity implemented during periods of immobilization.

Another less known purpose for PUM is to prevent cardiovascular deconditioning. Bedrest is detrimental to individual's cardiovascular functioning, independent of the disease state. Signs of cardiovascular deconditioning begin to appear within 3 to 4 days of bedrest.

ORTHOSTATIC INTOLERANCE DUE TO BEDREST

Orthostasis is the state of being in an upright position (sitting up, standing up, etc.). Orthostatic intolerance is one's inability to tolerate being in an upright position.

When an individual is confined to bedrest, several things occur. First, diuresis and natriuresis occurs, resulting in 10% to 20% reduction in circulating plasma volume. This affects stroke volume and cardiac output. A decrease cardiac output in a disease state can be detrimental to the recovery of the patient.

Baroreceptors are major stretch receptors located in the aorta and in the carotid sinus. These baroreceptors rapidly and continuously regulate blood pressure by responding to major smooth muscle fiber length. The receptors relay information to the autonomic nervous system to constrict/dilate blood vessels with changes in body position.

When an individual changes their gravitational reference from a lying to a sitting position, the body quickly goes through a series of physiologic adaptations to maintain cardiovascular homeostasis through the carotid-cardiac baroreceptors. With changes in gravitational plane (position changes), the stretch receptors read the shift in plasma volume and respond by sending information to the ANS to constrict the vasculature.

During bedrest, the patient is not regularly exposed to orthostatic "stress". Bedrest causes this normal regulatory mechanism to become sluggish if not utilized. Even in sleep, humans continue to move every 11.6 seconds to keep these mechanisms in optimum condition - a phenomenon described as "minimum physiological mobility requirement" (Raoof, 1999).

This is why orthostatic hypotension (decrease in both systolic and diastolic blood pressure upon upright posture) occurs frequently in patients who try to get up after prolonged bedrest. This increases the risk for falls, labile blood pressure, and other complications that may increase hospital length of stay.

Therefore, the obvious purpose of Progressive Upright Mobility training is to prevent musculoskeletal deconditioning; however, the primary hemodynamic purpose is to regularly induce orthostatic "stress" during the ICU admission to prevent orthostatic intolerance.

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PUM: EVIDENCE BASED LITERATURE

Bailey et al (2007). Early activity is feasible and safe in respiratory failure patients. Critical Care Medicine, 35(1), 139-145.

- n=103, 1449 recorded mobility activities.
- Purpose of study to determine whether early physical activity is safe for ICU patients with respiratory failure, and if they might improve physical functioning to the point that mot patients could ambulate by time of ICU discharge.
- Majority (69%) able to walk >100 feet by ICU discharge with no increase in nursing or ancillary staffing.
- Minor adverse events (falls without injury, SBP<90 or >210, oxygen desaturation <80%, tube feeding removal).

Morris (2007, oral presentation NTI)

- n=330.
- Created mobility team composed of nurses, nursing assistants, and PTs.
- Studied administration of early ICU mobility therapy.
- At end of study, # of days to out-of-bed decreased from 11 days to 5 days.
- One-fifth (1/5) of intubated patients got out-of-bed and liberated from ventilator sooner.
- No adverse outcomes (deaths, extubations).
- Most frequent reason for ending a mobility session was decrease in SaO_2.

Stiller, Phillips, & Lambert (2004). The safety of mobilisation and its effect on hemodynamic and respiratory status of intensive care patients. *Physiotherapy Theory and Practice, 20*, 175-185.

- n=31.
- Studied ICU patients and mobility.
- Concluded that while mobilization resulted in significant increases in HR and BP, and a non-significnt fall in SpO_2, deterioration in clinical status requiring intervention only occurred in 4.3% of occasions.
- Thus, "mobilization is a safe intervention for most subjects."

PUM: Standard of Practice

Refer to the copy of the Unit Specific Standard of Practice titled "Progressive Upright Mobility (PUM)" attached to the end of this packet

ASSESSMENT & INITIATION CRITERIA

(Review the Standards for Assessment and Initiation Criteria)

PUM is a **nurse-driven** initiative. Physical therapy consult is recommended; however, you should not wait for PT to initiate these steps.

6 STEPS *(Review the Standards for the 6 PUM Steps)*

FREQUENCY

1. Ensure that a PUM step is implemented at least three times a day (TID) and more as tolerated.
2. Progress each step duration 30 to 60 minutes.
3. Repeat each step until patient demonstrates hemodynamic and physical tolerance to stated activity/position for 60 minutes.
4. Advance to next step.

ADJUSTING TO THERAPY INTOLERANCE

If the patient is not tolerating the steps, adjust the plan of care by:

1. Educating and reassuring the patient; and/or decreasing the interval times to 15 to 30 minutes as appropriate.
2. Decreasing the interval times to 15-30 minutes (instead of 30 to 60 minutes).
3. If decreasing the interval time does not work, consider moving back to a lower step.

Try not to discontinue the PUM process. Reverse trendelenburg is also beneficial for orthostatic training if all other activity is not tolerated.

CONTRAINDICATIONS OR CARDIOPULMONARY INTOLERANCE

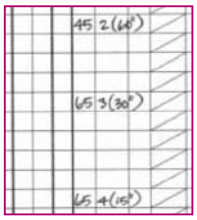
A plan exists even for those patients who have contraindications or are unable to tolerate the PUM steps. Reverse trendelenburg is still an effective method of orthostatic training by changing the gravitational plane, which induces the carotid-cardiac baroreceptors to react to the position change.

DISCONTINUATION CRITERIA

PUM is discontinued only when the patient is successfully ambulating.

DOCUMENTATION

Documentation is easy for PUM. In the "Activity/Position" column on the flowsheet, write in the HOB angle, step number completed and the duration in minutes in parentheses. Address tolerance to therapy and additional interventions in the Nursing Notes.



SKIN ASSESSMENT

Progressing the patient to an upright position in itself is a pressure-relieving mechanism for pressure ulcer prevention. However, because the minimum frequency is TID, you must still turn your patients every 2 hours and initiate skin care and pressure ulcer wound care standards, based on your assessment.

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Hill-Rom® Bed Functions for PUM

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PATIENT POSITIONING

When initiating PUM steps, remember to place the patient in the center of the bed and align the hips at the "Hip Indicator" landmark on the siderails so when the HOB is raised, the flexion occurs in the proper area. Do **not** align shoulders to the "Lung" landmarks. Again, check that all the tubing and catheters have enough slack.

FULLCHAIR® MODE TO FOOT EGRESS

The Hill-Rom series of beds have a unique feature in which it eases the patient into an upright standing position from the foot of the bed (instead of from the side of the bed). The bed has built-in capabilities to assist the patient into a standing position while minimizing the workload on the caregiver. This is done from a full chair position into what is called the "FullChair® Foot Egress". (Egress means exiting, leaving, moving out, etc.)

When the patient has reached PUM Steps 4 and up, you can continue from the FullChair® mode by initiating the Foot Egress:

1. The surface needs to be in "normal/standard" mode
2. Press the "Enable Key" button on the siderail to activate the buttons.
3. Hold the "Chair" button through the FullChair® mode (until the bed beeps)
4. Remove the foot board (yes … remove the foot board) to continue initiating the Foot Egress function.
5. After removing the foot board, continue to press the "Chair" button until the bed stops. This allows the bed to lower another 6+ inches and deflates the foot cushions. The Bariatric Plus bed also has a seat deflate option so it is easier for the feet to touch the floor.
6. Use the "Hi/Lo" key located on the upper siderail to raise (yes … raise) the patient into a standing position

To return the patient to bed, the patient can either reverse the process by sitting from the foot of the bed or the side of the bed.

Progressive Mobility™ Algorithm

Refer to Algorithm attached to the end of this packet. **Become familiar with the Algorithm. The CLRT and PUM Standards are to be utilized in conjunction with each other. The Algorithm is intended to help you initiate the appropriate therapy and to visualize the integration between the 2 Standards.**

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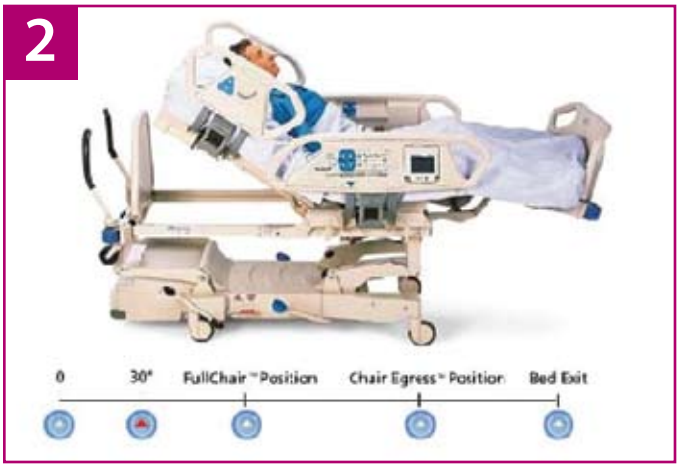
FullChair® Mode to Foot Egress

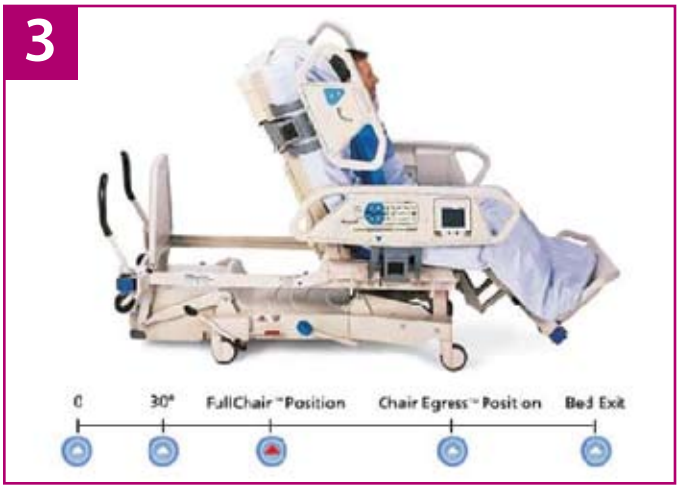
1

2



Lift HOB to 30 degrees.

3



Hold the "Chair" button through the FullChair® mode until the bed beeps.

4

Remove the foot board. Continue to press the "Chair" button until the bed stops. This allows the bed to lower another 6+ inches; deflates seat; and deflates foot cushions so feet touches the floor.

5

Use the "Hi/Lo" key located on the upper siderail to raise the bed (and patient) into a standing position.

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The University of Kansas Hospital
Addendum

University of Kansas Hospital Department of Nursing Adult Critical Care

SECTION: Standard of Practice and Procedures	EFFECTIVE: 2/20/07
TITLE: Continuous Lateral Rotation Therapy (CLRT)	

PATIENT OUTCOMES:

1. Patient will have decreased ventilator days.
2. Patient will have decreased incidence of respiratory complications.
3. Patient will not experience a decrease in level of deconditioning related to immobility.

STANDARDS OF PRACTICE:

In the care of all patients the RN will:

Assessment and Initiation of CLRT

1. Assess the patient for CLRT upon admission, then every shift, initiate CLRT if the patient is immobile/has ineffective mobility, plus one or more of the following:
   - Lobar collapse/atelectasis or excessive secretions, and/or
   - PaO_2/FiO_2 ratio <300, and/or
   - Hemodynamic instability with manual turning
2. Assess the patient for contraindications to CLRT such as activity restrictions due to:
   - Diagnosis or Condition e.g. spinal cord injury, unstable intracranial pressure, etc.
   - Devices e.g. traction, ventriculostomy while draining, etc.
   - Therapies e.g. during CRRT, hemodialysis, etc.
   - Comfort Care
3. Obtain physician order for appropriate lateral rotation bed, taking into consideration patient weight and need for pressure relief surface.
4. Document date and time of CLRT initiation and criteria met for CLRT in the nursing notes.

Management of Patient on CLRT

5. Implement the following goals for rotational therapy to ensure optimal pulmonary outcomes:
   - Set % rotation to achieve one lung above the other (minimum 70%; ideal 100%).
   - Ensure patient is rotated a minimum 18 out of 24 hours.
   - Set pause times of 2 minutes each for left, center, and right.
   - Ensure rotation is not stopped for more than 45 minutes at a time or a maximum of 6 hours within 24 hours for procedures/interventions.
6. Assess vital signs, ECG, SpO_2 for two complete rotations when (re)initiating therapy and with every change in rotation parameters. Allow a 5 to 10 minute equilibration period before determining hemodynamic instability after any position change.
7. Assess patient's tolerance to therapy and adjust plan of care to manage agitation, intolerance, or desaturation as follows:
   - Educate and reassure patient
   - Increase pause times (first, before attempting to decrease rotation %)
   - Decrease % rotation or use "Training" mode for gradual increases (↑rotation by 10% every hour).
   - Address sedation needs
8. Obtain ABGs with patient in center position.
9. Assess skin every 2 hours by temporarily stopping lateral rotation. Inspect the posterior surface and at-risk areas. If pressure relief is indicated, offload the sacrum or other surfaces with positioning device (e.g. wedge) to allow for circulatory recovery. **Remove** the positioning device prior to restarting therapy. **Wedges are not to be used during rotation.**
10. Evaluate patient response to treatment and progress towards expected outcomes, every shift, by assessing and documenting the following: ABG and P/F ratio when available
    - Improvement or deterioration in pulmonary assessment

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11. Document with initial shift assessment and at midnight, in the "Kinetic Therapy" box on the critical care flow sheet: % rotation (left, right)
    - Pause times (left, center, right)
    - Number of hours in rotation since midnight

12. Document when appropriate, in the nursing notes: Patient tolerance
    - Adjustments to therapy/interventions
    - Rationale for any periods in which rotation was stopped in excess of 6 hours in 24 hours.

Discontinuation of CLRT

13. Evaluate every shift for discontinuation of CLRT and discontinue CLRT if any one of the following 4 criteria is met:
    a. Therapy goals have changed to comfort care only, and/or
    b. Contraindication(s) have developed, and/or
    c. Patient is transferring out of the ICU, and/or
    d. Cardiopulmonary stability and mobility is evident by:
    - CXR improved/resolving infiltrates, and
    - P/F Ratio >300, and
    - Hemodynamically stable, and
    - Improved secretion management, and
    - Patient turns self with moderate assistance only

14. Document date and time CLRT discontinued, including the criteria met for discontinuation. Continue to assess for re-initiation of CLRT every shift.

15. Apply CLRT in conjunction with Progressive Upright Mobility SOP and Progressive Mobility Algorithm for Critically Ill Patients (attached).

PROCEDURE COMPETENCY LEVEL: RN

1. Wash hands and put on gloves.
2. Remove any pillows behind patient's head (rotation beds have "built-in pillow" at head of bed for occipital pressure relief).
3. Position patient in the center of the bed.
4. Align patient's shoulders with the "Lung" landmark located on the upper siderails.
5. Verify that the HOB is no greater than 40 degrees (unless contraindicated)
6. Position tubes, catheters, and equipment appropriately to accommodate movement from side to side and prevent accidental dislodgment.
7. Program settings as stated in Management of Patient on CLRT above.

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University of Kansas Hospital Department of Nursing Adult Critical Care

SECTION: Standard of Practice and Procedures	EFFECTIVE: 2/20/07
TITLE: Progressive Upright Mobility (PUM)	

PATIENT OUTCOMES:

1. Patient will experience improved physical conditioning.
2. Patient will demonstrate hemodynamic stability (no orthostasis) with upright mobility.

STANDARDS OF PRACTICE:

In the care of all patients the RN will:

Assessment for PUM

1. Assess the patient for Progressive Upright Mobility (PUM) upon admission, then every shift, and initiate PUM if answer is "yes" to one or more of the following questions and patient is free from any contraindications:
   - Is patient at risk for deconditioning due to immobility?
   - Does patient require orthostatic training to upright position?
2. Assess the patient for contraindications to PUM such as activity restrictions due to:
   - Diagnosis or Condition e.g. spinal cord injury, unstable intracranial pressure, etc.
   - Devices e.g. femoral sheaths, traction, ventriculostomy while draining, etc.
   - Therapies e.g. during CRRT, hemodialysis, etc.
   - Comfort Care
3. Apply PUM in conjunction with Continuous Lateral Rotation Therapy SOP and Progressive Mobility Algorithm for Critically Ill Patients (attached).

Initiation and Management of Patient Undergoing PUM

1. Advance patient through the following PUM steps 1-6:

Progressive Upright Mobility (PUM) Steps

Step 1	HOB elevated to 45º
Step 2	HOB elevated to 45º plus legs in dependent position (cardiac chair or partial chair using chair mode)
Step 3	HOB elevated to 65º plus legs in full dependent position (full chair mode or cardiac chair)
Step 4	HOB elevated to 65º plus legs in full dependent position and feet on the floor plus standing
Step 5	Initiate stand/pivot and into chair
Step 6	Initiate stand/pivot with march stepping and into chair

2. Ensure that a PUM step is implemented at least three times/day and more frequently as tolerated.
3. Evaluate cardiopulmonary tolerance to each position change by assessing vital signs, ECG, and SpO_2. Allow a 5 minute equilibration period after the position change before determining cardiopulmonary stability.
4. Progress each step to 30 to 60 minutes as patient tolerates.
5. Repeat each step until patient demonstrates hemodynamic and physical tolerance to stated activity/position for 60 minutes, then advance to next step at the next activity period.
6. Initiate orthostatic training TID using reverse trendelenburg if patient demonstrates cardiopulmonary intolerance or contraindications to PUM. Continue to assess for PUM (re)initiation when patient demonstrates stability (no orthostasis) with upright mobility.

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7. Adjust plan of care to manage intolerance as follows:
   - Educate and reassure patient
   - Decrease interval times to 15-30 minutes
8. Document with each activity period under the "Activity/Position" column on the flow sheet:
   - Step(s) # completed
   - Duration in minutes
9. Document when appropriate, in the nursing notes:
   - Patient response to therapy
   - Adjustments to therapy/interventions

Discontinuation of PUM

1. Discontinue PUM when the patient is successfully ambulating.
2. Assess for re-initiation of PUM every shift.

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The University of Kansas Hospital

Progressive Mobility Algorithm
for Critically Ill Patients*

University of Kansas Hospital Department of Nursing Adult Critical Care

Assess **every shift** for pulmonary complications and deconditioning as outlined in the Continuous Lateral Rotation Therapy (CLRT) SOP and the Progressive Upright Mobility SOP. Both SOPs are to be utilized in conjunction with each other.

Start Here

Assess patient for the following:
- Is patient at risk for deconditioning due to immobility? OR
- Does patient require orthostatic training to upright position?

CONTRAINDICATIONS
Activity restrictions due to:
- Diagnosis (e.g. spinal cord injury, unstable intracranial pressure)
- Devices (e.g. traction, ventriculostomy while draining)
- Therapies (e.g. during HD, CRRT)
- Comfort Care

Y

N

Y

Is patient immobile or have ineffective mobility plus one or more…
- Lobar collapse, atelectasis, or excessive secretions
- P/F Ratio <300
- Hemodynamic instability with manual turning (↓O2Sat, ↓BP, ↑HR)

Y

Initiate/Continue CLRT if free from contraindications

Assess skin q2 hours.
Temporarily offload pressure areas as necessary for circulatory recovery. **Wedges are not to be used during rotation.**

N

N

Assess every shift, patient progress towards expected outcomes; adherence to rotation goals; and tolerance to therapy.

Does patient meet CLRT discontinuation criteria?
- CXR improved/resolving infiltrates; and P/F ratio >300; and hemodynamically stable; and improved secretion management; and patient turns self, OR
- Contraindication(s) have developed, OR
- Comfort Care

Y

Initiate or Continue PUM Steps if free from contraindications

N

Is patient successfully ambulating?

Y

Discontinue Progressive Mobility Efforts and continue to ambulate (reassess every shift)

PROGRESSIVE UPRIGHT MOBILITY STEPS: Progress each step to 30-60 minutes. Ensure that a step is implemented at least ***three times/day*** and more frequently as tolerated. Repeat each step until patient demonstrates hemodynamic and physical tolerance to stated activity/position, then advance to next step, at the next activity period.

STEP 1: HOB elevated 45°*
STEP 2: HOB elevated 45° plus legs in dependent position (partial chair mode or cardiac chair)
STEP 3: HOB elevated 65° plus legs in full dependent position (full bed chair mode/ or cardiac chair)
STEP 4: HOB elevated 65° plus legs in full dependent position and feet on the floor plus standing
STEP 5: Initiate stand/pivot and into chair
STEP 6: Initiate stand/pivot with march stepping and into chair
***If cardiopulmonary intolerance or contraindications develop, use *reverse trendelenburg* for orthostatic training TID, until resolved.**

*Modified from Kathleen Vollman's Advancing Nursing @ www.vollman.com

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Kubo, A.

Self-Directed Study Quiz

Progressive Mobility™ Therapy in the ICU

Continuous Lateral Rotation Therapy (CLRT)
Progressive Upright Mobility (PUM)

Answers on page 19.

1. CLRT is hypothesized to do the following:
   a. Decrease functional residual capacity
   b. Decrease VAP, atelectasis, ARDS
   c. Prevent skin breakdown
   d. Increase shunting

2. Step #4 in the Progressive Upright Mobility steps includes which activit(ies)?
   a. HOB elevated to 45 degrees
   b. HOB elevated to 70 degrees
   c. Initiate stand/pivot with march stepping
   d. HOB elevated to 65 degrees; legs in full dependent position; feet on floor

3. **True or False:** ALI/ARDS is characterized by bilateral diffuse infiltrates on x-ray, hypoxemia, and non-cardiogenic (i.e. non-left heart failure) pulmonary edema.

4. **True or False:** Reverse trendelenburg is an effective method of orthostatic conditioning for patients with contraindications to PUM or exhibiting cardiopulmonary intolerance.

5. The hallmark pathophysiologic problem with ALI/ARDS is:
   a. Massive inflammation in the lungs caused only by direct pulmonary insult (i.e. aspiration pneumonia)
   b. Gradual decrease in surfactant production by the alveolar epithelium, causing atelectasis
   c. Non-uniform structural damage to the AC membrane, producing severe pulmonary edema, shunting, and hypoxemia
   d. Excessive oncotic pressure in the pulmonary arterial bed, causing pulmonary edema

6. Which of the following P/F ratio is the criteria for CLRT?
   a. <200
   b. <250
   c. <300
   d. <350

7. If the patient is not tolerating the current rotation therapy, you should do the following:
   a. First, decrease pause times, then increase % rotation
   b. First increase pause times, then decrease % rotation
   c. Decrease sedation
   d. Discontinue rotation

8. The effect of bedrest on the cardiovascular system include:
   a. Orthostatic hypotension
   b. 10 to 20 percent increase in plasma volume
   c. Increased cardiac output
   d. Enhanced response by the autonomic nervous system to constrict blood vessels

9. **True or False:** The wedge/positioning device must be removed prior to re-starting rotation therapy.

10. Calculate the P/F Ratio based upon the following information:
    pH 7.33; PaO_2 60; $PaCO_2$ 48; HCO_3 25; SaO_2 90%; FiO_2 0.50; PEEP 10; V_T 500

11. **True or False:** It is unnecessary to manually turn the patient every 2 hours while on rotation therapy.

12. Fill in the blanks with the 4 words (a through d) required to complete this sentence:
    "The obvious purpose of Progressive Upright Mobility training is to prevent ___(a)___ deconditioning; however, the primary ___(b)___ purpose is to regularly induce ___(c)___ 'stress' during the ICU admission to prevent orthostatic ___(d)___ due to bedrest."

13. How is the total number of hours in rotation documented in the CLRT section of the flowsheet?
    a. Record the number of hours rotated during the last shift
    b. Record the number of hours in rotation since midnight at the beginning of each shift and at midnight
    c. Record the total number of hours rotated during your shift
    d. Record the total number of hours once at midnight

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Kubo, A.

Self-Directed Study Quiz

Progressive Mobility™ Therapy in the ICU

Continuous Lateral Rotation Therapy (CLRT)
Progressive Upright Mobility (PUM)

14. **True or False:** CLRT is initiated when the patient is immobile or has ineffective mobility, plus hemodynamic instability with manual turning.

Refer to the Progressive Mobility Algorithm to answer questions 15-20 based upon the following case scenario:

Mr. Smith is a 65-year old, 375 pound patient admitted to the MICU with severe sepsis. History includes hypertension, a-fib, DMII, and takes Coumadin at home. Most recent lactate is 4.2; H/H 8.6/28%; blood glucose 195; Cr 3.1; $ScvO_2$ 85%; HR 112; BP 105/50 with MAP 68 on norepinephrine and neosynephrine gtt; echo showed EF of 30%. He is mechanically ventilated with the following setting — PC mode; FiO_2 .80; PEEP 10; Rate 15. The last ABG read — pH 7.34; PaO_2 62; $PaCO_2$ 44; HCO_3 19; SaO_2 90%. The family has decided that he is a DNR.

15. Does the patient meet criteria for CLRT?
    a. Yes
    b. No

16. Which bed will you order?
    a. Hill-Rom® TotalCare® SpO_2RT®
    b. Hill-Rom® Bariatric Plus

17. During your q2 hour skin assessment, you notice redness to the coccyx area. You decide to temporarily stop rotation and offload the coccyx with a wedge. How long will you offload the pressure area before resuming CLRT?
    a. 15 minutes
    b. 30 minutes
    c. 1 hour
    d. As long as necessary for circulatory recovery while adhering to 18 hours/day rotation goal.

18. When the patient is undergoing CLRT, all ABGs should be obtained with the patient in the center position.
    a. True
    b. False

19. After 5 days of CLRT, Mr. Smith shows signs of improvement. HR 89; BP 149/87 no pressors; RR 18; the am CXR shows resolving infiltrates; and is ventilated on PS 5/5 @ 40%. Mr. Smith is later extubated and the post-extubation ABG shows pH 7.40; PaO_2 75; CO_2 41; HCO_3 26; SaO_2 94% on 4L O_2. He has an effective cough with minimal sputum. He is able to assist with turning. Does Mr. Smith meet CLRT discontinuation criteria?
    a. Yes
    b. No

20. What is the next step towards mobility for Mr. Smith?
    a. Use reverse trendelenburg TID
    b. Initiate Progressive Upright Mobility steps 1-6
    c. Wait for PT consult
    d. Let the acute care floor handle mobility issues

ANSWERS

1. b
2. d
3. T
4. T
5. c
6. c
7. b
8. a
9. T
10. 120
11. F
12. a – musculoskeletal
b – hemodynamic
c – orthostatic
d – intolerance
13. b
14. T
15. a
16. b
17. d
18. a
19. a
20. b

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