Protocol for Early Rehabilitation in patients with Neurotrauma

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Brain Injury is a leading cause of death and disability worldwide.

Injuries to the brain are among the most likely to result in death and permanent disability.
The Changing Trend

- As emergency and intensive care has improved the mortality due to traumatic brain injury has reduced too but the net result of reduced mortality is increased disability. More individuals with severe brain trauma are surviving the acute insult only to be rendered disabled by primary insult or secondary complications. This is placing an increased burden on health and social care resources.
QUESTIONS

• DOES EARLY REHABILITATION WORK?
• HOW EARLY IS EARLY?
• WHY EARLY REHABILITATION?
• WHAT SHAPE SHOULD IT TAKE?
• CAN WE SET A PROTOCOL FOR EARLY REHABILITATION IN BRAIN INJURY?
Does Early Rehabilitation Work

- Limited numbers of studies
- Most studies are inconclusive.
- Imperfect design
- A critical review of the literature on early rehabilitation of patients with post-traumatic amnesia in acute care; Leanne Langhorn; Jens C Sorensen; Preben U Pedersen; Journal of Clinical Nursing; Volume 19, Issue 21-22, pages 2959–2969, November 2010 concluded the following:
  - Six reviews and 11 original studies were included and comprised the review. Many studies used weak designs and small sample size, thus limiting their ability to control confusing variables and outcomes.
  - Hence we can not be sure what we do really works; But What do we do and what should we do and most importantly WHY
How Early is Early

- Rehabilitation team should assess the patient within 24-48 hours of admission.
- The assessment should lead to Rehabilitation programme plan with clear timelines, targets and objectives.
- The definition of Early Rehabilitation in literature is suggested as being rehabilitation treatment that is commenced within one month.
- Stroke shows that early interventions are effective.
- What is the right approach?
Clinical Experience

• Over the past 20 years in Rehabilitation Medicine I have seen patients when referred for rehabilitation in a very varied states even when the underlying injury is comparable

• Often the patients are in less than satisfactory state of physical and psychological wellbeing

• A fair number have often acquired impairments and morbidities (In-Hospital) that could have been prevented

• The Rehabilitation Team often has to engage in restorative process prior to rehabilitation to gain rehabilitation readiness status

• This results in:
  • Longer Length of Stay
  • Less than otherwise optimal or potential outcome
Prolonged time in acute care is at a heavy price

- A patient with brain injury may become bed fast due to several factors:
  - Coma
  - Associated trauma
  - Cognitive or behavioural impairments
  - Paresis
- Immobility and bed fast status can result in anatomical, physiological and biochemical changes that can often take months or even years to resolve
- This slows the recovery and has a negative impact on the overall outcome
What Happens to a person when confined to Bed

- **Anatomical Changes due to Disuse**
  - Loss of muscle strength and endurance
    - Disuse of the muscles leads to atrophy and a loss of muscle strength at a rate of around 12% per week (Jiricka, 2008)
    - After 3–5 weeks of bed rest, almost half the normal strength of a muscle is lost.
    - When muscles are immobilized, they shorten. A programme of immediate or early motion may prevent muscle atrophy (evidence is emerging)
  - **Bone Loss**
    - During immobility, both cortical and trabecular bone are lost. Bone mineral density of the vertebral column decreases by about 1% per week of bed rest, nearly 50 times that of normal age-related bone loss
    - Between 24% and 40% of the mass of the heel bone is lost during 36 weeks of bed rest (Bortz, 1984)
What Happens to person when confined to Bed

- Changes due to Disuse (continued)
  - Gastrointestinal “slowdown”
    - Bed rest is associated with a reduced sense of taste, smell and a loss of appetite (Rousseau, 1993; Bortz, 1984)
    - The resulting drop in food intake leads to progressive disuse of the gastrointestinal (GI) tract
    - This can have a major impact on gut structure and function, including atrophy of the mucosal lining and shrinkage of glandular structures (Bortz, 1984)
    - Increased Transit time
    - Constipation
  - Respiratory Inefficiency
    - Prolonged bed rest is associated with several time-dependent effects on respiratory function
    - In supine position, the weight of the body restricts the free movement of the rib cage, reducing tidal volume sometimes by as much as from 78% to around 32%
    - Respiratory Muscle weakness and fatigue {Direct effect of assisted ventilation, Tracheostomy low resistance breathing / O2 therapy, Low physical activity with low demand on respiratory effort}
What Happens to person when confined to Bed

- Changes due to Disuse
  - Cardiovascular Inefficiency
    - The cardiac muscle fibers within the myocardium need the stress of physical work to stay healthy
    - With rest and reduced activity stroke volume decreases
    - As stroke volume decreases, the myocardium is required to do less work and begins to atrophy
    - Myocardial thinning, particularly in the ventricular regions, is common in both male and female bedridden patients (Dorfman et al, 2007)
  - Urological
    - Free catheter drainage may reduce the bladder holding capacity
    - Detrusor muscle weakness
  - Neurological
    - Cognitive “slowdown”
      - Orientation deficits
      - Unreliability of memory
      - Declining decisional capacity
      - Intellectual disengagement leading disempowerment
What Happens to person when confined to Bed

- Changes due to Dysregulation
  - Haematologic
    - Reduction in Blood Volume
    - When a person is supine, the shift of blood from the legs into the thorax increases atrial stretch. This stimulates the release of Atrial Natriuretic Peptide. Diuresis occurs leading to significant water loss.
    - This same shift of blood stretches the aortic arch and carotid sinus baroreceptors, which reduces ADH release from the posterior pituitary. As the levels of plasma ADH fall, less water is reabsorbed in the kidney, further increasing the diuretic effect of ANP. The result is an increase in urine output and a progressive reduction in blood volume that can often lead to dehydration.
  - Increased Viscosity / Coagulability
  - Because of skeletal muscle atrophy associated with bed rest, there is a gradual reduction in oxygen demand. This can be seen in the drop in erythropoiesis, resulting in a drop in erythrocyte numbers, total red cell mass and total haemoglobin level (Kaplan, 2005)
What Happens to person when confined to Bed

- Changes due to Dysregulation
  - Vascular
    - Postural Hypotension
      - Reduced blood volume can lead to greater drops in blood pressure on standing;
      - Blunting of baroreceptor reflexes, as reduced blood volume produces less of a stretch stimulus and the stretch receptors progressively become less sensitive;
      - Reduced venous return and stroke volume;
      - Cardiac deconditioning and myocardial thinning, which limits the pump effectiveness of the heart.
    - Postural hypotension is one of the first problems to be seen in bedridden patients and has been noted after as little as 20 hours of bed rest (Gaffney, 1985)
What Happens to person when confined to Bed

- Changes due to Dysregulation
  - Gastrointestinal
    - During bed rest, gastric bicarbonate secretion may decrease (Kaplan, 2005), increasing acidity within the stomach.
    - When patients are in the supine position, the gastric secretions can collect and press against the lower oesophageal (cardiac) sphincter, causing irritation, reflux and gastric inflammation.
  - Respiratory
    - Airway obstruction, potentially due to pooled mucus.
    - Increased resistance in the airways and a loss of elastic recoil as a result of structural changes within the lungs (Manning et al, 1999).
What Happens to person when confined to Bed

- Posture or position imposed soft tissue stretch loss or tissue breakdown
  - Changes in the structure and function of connective tissue become apparent four to six days after immobility begins and these changes remain even after normal activity has been resumed
  - Ligament complexes are affected biomechanically, biochemically and morphologically by immobility. Experiments show that ligament stiffness and load-bearing ability drop to 69% and 61% below normal respectively, and that ligaments may not return to normal even after one year (Zarrins, 1982)
  - These tissue changes if left unchallenged may result in development of contractures.
  - 2–3 weeks of immobilization produces a much firmer contracture, and this is a frequent complication of bed rest. Muscle atrophy plays a part in the development of contractures because of the abnormal shortening and weakening of the muscle fibers
What Happens to a Person when Confined to Bed

- Posture or position imposed soft tissue stretch loss or tissue breakdown
  - Prolonged pressure (greater than capillary pressure of 32mmHg) can result in ischemia and necrosis of underlying tissues. The longer the duration and the greater the magnitude of pressure, the higher the chance of developing a pressure ulcer. Microscopic changes to skin tissue have been observed with pressures of 70mmHg after only two hours.
  - Areas where skin is stretched tautly over bony prominences are at the highest risk of breakdown.
  - Here, the possibility of ischemia is at its greatest because skin capillaries are compressed between the bone and a hard surface such as a bed or chair (Gulanick and Myers, 2006).
What Happens to person when confined to Bed

- **Critical Illness Associated Idiopathic Neuromuscular Dysfunction**
  - **Critical Illness Neuropathy**
    - Critical illness neuropathy affects peripheral nerves, occurring as a complication of severe trauma or infection (critical illness). It develops while patients are in the intensive care unit and typically presents with sensory symptoms and muscular weakness. It is a clinical diagnosis supported by nerve conduction studies.
    - It should be suspected if there is an unexplained difficulty in weaning a patient from mechanical ventilation, fingers or toes begin to claw, intrinsic muscles of hands and feet begin to show wasting at a rate or in a manner that is not congruent with primary pathology or patients begin to complain of dysaesthesia or pain that has neurogenic features.
    - The exact cause is not known.
  - **Critical Illness Myopathy**
    - The term CIM or ICU Myopathy is now used to describe a general syndrome of muscle dysfunction occurring in the critically ill patient.
    - The major feature of CIM is diffuse, flaccid weakness of limb, neck, and facial muscles, as well as the diaphragm. Ophthalmoplegia may be present and tendon reflexes are often depressed. The timing of critical illness myopathy onset is difficult to determine, but by definition weakness must present after the onset of critical illness. Currently, the overall occurrence of CIM is unknown because of non-uniformity in studies of patient case mixes, diagnostic criteria used, and timing of evaluation for CIM.
    - Diagnosis is on the basis EMG and CK levels.
What Happens to person when confined to Bed

- Emotional or psychological disrepair
  - Persistent Stress
  - Persistent Anxiety
  - Persistent Fear
  - No “Regroup Time”
  - “Add On” and cumulative emotional and psychological “injury”
  - No “repair retreat”
Early Rehabilitation Principle

All that is not hurt or effected by the primary pathological process should and must be preserved

- Joint Range of Motion
- Tissue Elasticity
- Tissue Integrity
- Circulatory Efficiency
- Respiratory capacity
- Muscle strength
- Neurological Status
- Nutritional Status
- Psychological Reactions
- Cognitive ability
How Early is Early
When should Rehabilitation begin after Brain Injury

• Harold Wilson (former British Prime Minister) famously said in 1948: “A week is a longtime in politics”

• We should use the same principle in brain injury rehabilitation.

• Current upper limit of early rehabilitation of one month is too long

• Any intervention that starts after 10 days should be termed subacute

• Early rehabilitation should be a part of overall acute care and rehabilitation team must become engaged within the first week.
Early Rehabilitation in Brain Injury

- Maintain good nutrition
- Maintain bladder and bowel functioning (maintain bladder holding capacity / avoid free drainage)
- Handle pain through physical modalities as adjuvant to pharmacological regime. AVOID OVERSEDATION
- Where possible start active mobilization
- Maintain joint range of motion
- Maintain tissue integrity
- Early sitting out in chair or sitting on the side of the bed. Even 5 minutes every 2 – 4 hours has shown to have good effect
- Allow OFF VENT periods if and when possible (even very short periods of few minutes) every 4 - 6 hours
Early Rehabilitation in Brain Injury: Cognitive Vigilance and PTA

- Early assessment for disturbance of consciousness is necessary and level of disturbance must be established.
- Early diagnosis of Post traumatic Amnesia is essential.

  - Post-traumatic amnesia (PTA) is a state of confusion that occurs immediately following a (TBI) in which the injured person is disoriented and unable to remember events that occur after injury. The person may be unable to state his or her name, where he or she is, and what time it is. When continuous memory returns, PTA is considered to have resolved. While PTA lasts, new events cannot be stored in the memory.
Rehabilitation of patient in Post Traumatic Amnesia

- Low noise environment
- Avoid chaotic routine
- Gentle Introduction of yourself every time you attend to patient
- Explain what is being done before it is done
- Avoid “REMINDERS”
- Avoid restraining (both chemically and certainly physically) as much as possible
- Least amount of chemically induced disturbance of consciousness
Post-Brain Injury Early Rehabilitation Protocol 1

This protocol is based on strict adherence to an isometric, isotonic and mobilization routine as well as on measures to maintain cognitive vigilance and active functional participation. The protocol is of course for the patients who are not comatose and should begin as soon as active participatory status is gained. The key elements of the protocol are as follows:

- Muscular strength and Cardiac Function
  - Sponge tennis ball squeeze 5 times in each hand (or unaffected hand only) every 1 to 2 hours (depending on patients participation ability) with squeeze maintained for up to 2 seconds each time.
  - Up to maximum of 500 gms weight training with each upper limb (or unaffected side only) five elbow flexion / extension on each side, every two hours – 4 hours (depending on patients participation ability) holding extension for 3 seconds each time.
  - Up to 300 gms weight training either side or unaffected side only with shoulder flexion / extension twice daily, holding 90 degrees flexion for up to 2 second each time.
  - Hourly Flexion extension of the lower limbs (unaffected) in bed or in chair
  - Every two hours foot dorsiflexion and knee flexion / extension against resistance (physiotherapy Elastic band / Therraband).
Post-Brain Injury Early Rehabilitation Protocol 2

- Respiratory Function (if needed):
  - Physiotherapy elastic Band (therraband) assisted chest expansion up to 5 stretches every 3 hours (depending on patient’s participation ability).
  - Five deep breaths every hour
  - Five forced coughs every three hours
- Incremental out of bed sitting regime starting as early as feasible and aiming a sitting out time of up to 6 hours in 3 two hours intervals during 12 hours.
- Incremental bipedal or one leg assisted or independent stand to maximum tolerated time twice daily as soon as feasible or tolerated.
- Encourage news watch / paper reading with discussion on active stories, encourage schedule awareness BUT not in patients in PTA
- Early return to vocation (use of lap top to answer emails etc as early as feasible) even in acute setting
Post-Brain Injury Early Rehabilitation Protocol 3

- Modify or adjust the protocol for:
  - Fatigue
  - Headache
  - Dizziness
  - Concentration difficulties
  - Irritability
  - In essence individually tailor it
• In my experience the outcomes with the proposed protocol are significantly better than the conventional treatment model. Can share case studies
• However in my institution there is no possibility to conduct research or audit due to lack of resources especially in the ICU
• Hence I am unable to provide reliable quantitative data as the entries in charts particularly those related to rehabilitation in ICU are erratic and unreliable
• Formal test of the proposed protocol is required
Need for further work

- PARAMOUNT on the lines that happened in stroke
- Current brain / head injury guidelines are drawn primarily with "survival" consideration and have indeed been effective. We now need to move forward to bring "Quality of Survival" consideration to the fore and add to current guidelines the early rehabilitation protocol that is quantifiable and has firm basis avoiding generic terms as mobilization or physiotherapy.
Summary

Patients with brain injury have to be attended for survival initially but long-term out come must also be a concern from very early phase of brain injury management. Therefore, in tandem with the efforts to save life it is imperative that the life saved remains worth living, commands quality and comfort. It is essential that the Early / acute / intensive care teams and rehabilitation teams should begin to work closely in order to prevent unwanted consequences of brain trauma and ICU / acute care related complications that may contribute to long-term morbidity and dependence and put an individual at risk of low quality of life.
Thank you