Rehabilitation of burn patients

Monratta Panuwannakorn
Department of Rehabilitation Medicine
Ramathibodi Hospital

Rehabilitation of burn patients

- Should begin soon after burn to try to prevent deformities and poor functional outcomes

Rehabilitation of burn patients

Divided into 4 phases
- Emergent phase
- Acute phase
- Post skin graft phase
- Convalescent phase

The emergent phase

- Begin in the first 24 – 72 hrs after burn injury

The emergent phase

Goals
- To evaluate the patient and develop treatment goal & plan
- To control edema
- To maintain ROM of the injured part
- To prevent respiratory complication, esp. in inhalation burn

Initial evaluation

- Depth & area of burn wounds
- Observe the wound: exposed tendon or joint
- Edema
- Pain
- ROM
- Function
- Cooperation of the patient

Initial evaluation

- Depth & area of burn wounds
- Observe the wound: exposed tendon or joint
- Edema
- Pain
- ROM
- Function
- Cooperation of the patient
Burn severity

Burn evaluation

Edema
- Result from fluid shift to extravascular space
- Develop 8 – 12 hrs. after burn injury peak 36 hrs.
- Result in: ischemia & fibrosis
  - places the extremities in deforming position
  - limited movement
  - interfere function

Edema
- In SPT burn: fluid leakage has low protein content and transient
- In DPT and FT burn:
  - both dermis and papillary plexus are injured
  - fluid leakage has high protein content and rich in fibroblast cause prolonged and severe edema

Control edema & maintain joint mobility
- Control edema is imperative in this stage
- Thick inelastic eschar often necessitates escharotomy to release pressure
- Escharotomy do not preclude exercise

Control edema
- Elevation & positioning
  - elevate above heart level
  - avoid position that compromise circulation
- Active muscle pumping exercise in elevated position
  - depend on conscious & motivation of the patient and burn wound condition
- Compressive dressing / wrapping
Elevation & positioning

Prevent respiratory complication
- Inhalation injury can cause mild to severe bronchial and alveolar changes
- Inhalation injury combined with edema formation and constricting eschar of neck can obstruct the trachea necessitate intubation and mechanical ventilation

Pulmonary rehabilitation program
- Bronchial hygiene therapy:
  - postural drainage, percussion, vibration
  - cough training
- Improve ventilation & prevent atelectasis:
  - deep breathing, incentive spirometry

Pulmonary rehabilitation

Acute phase
- Extend from emergent phase until wound closure
- Early and proper intervention: necessary for collagen fibers orientation to minimize scar formation
**Acute phase**

**Goal**
- Control edema
- Maintain joint, skin mobility, muscle strength and prevent stiffness / contracture
- Promote mobility and ambulation
- Encourage functional independence

**Control edema**
- Elevation
- Positioning
- Compression : EB
- Exercise
- Functional activities

**Maintain joint and skin mobility & prevent stiffness/contracture**
- Positioning
- Exercise
- Continuous passive motion
- Splinting

**Positioning**
- Combine appropriate position and compliance of the patient
- Appropriate position : antideformity
- Change every 2-4 hrs.

**Antideformity position**
- Designed to counteract the forces and patterns of wound contraction and scaring
- Required combined effort of rehabilitative and nursing staffs
- Require frequent repositioning

**Comfortable position**
Antideformity position & repositioning

Positioning lower extremities

Splint for positioning wrist & hand

Exercise

- Type and duration depend on conscious, motivation, burn wound condition and pain

Exercise

- Prolonged immobilization will result in:
  - decrease cardiovascular fitness
  - muscle atrophy & weakness
  - joint stiffness
  - disuse osteoporosis
  - increase risk of thromboemboli
  - decubitus ulcer

Exercise

- Active / active assistive exercise
  - need patient’s motivation & coordination
  - counteract the effect of prolonged bed rest & muscle atrophy
  - maintain ROM & strength
  - provide emotional support to the patient
Exercise

- Passive exercise
  - for patient who can not or does not willing to actively move: critically ill, sepsis, heavily medicated patient
  - to maintain ROM, elongate tissue and assess joint motion

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface
  - Avoid unnecessary bulky dressing

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface

- Avoid unnecessary bulky dressing

Children

- Exhibit increased pain reactions during exercise due to fear and apprehension
- Playing and group activities are more appropriate to encourage active movement

Passive, active assistive, active exercise

- Use to maintain or restore ROM
- Most benefit in:
  - extensive burn covering multiple area
  - impaired cognitive function
  - can not do appropriate motion due to pain,edema and anxiety
  - require passive motion for a prolonged time
Continuous passive motion

Contraindication/precaution for ROM exercise
- Exposed tendon
- Ruptured tendon, exposed joint or fracture

Splinting
- All burn patient are not necessary routinely splinted
- Splinting depend on:
  - depth and extent of wound
  - ROM & strength
  - co-operation with exercise, positioning and ADL

Splinting
- Splinting is necessary in:
  - unconscious or non-co-operative patient
  - non-co-operative children
  - immobilize the affected part: exposed tendon, exposed joint
  - muscle weakness or imbalance: peripheral nerve injury

Functional activities
- Encourage performing self care activities
  - increased ROM, strength and endurance of U/E muscles
- May need adaptive devices: built-up utensils, adaptive cup, plate guard

Assistive & adaptive devices
Encourage functional & playing activities

Mobility and ambulation
- Ambulation should begin as soon as the medical condition stable
- Benefit of early ambulation
  - Maintain or increase ROM, strength and endurance of L/Es muscles
  - Provide cardiovascular conditioning
  - Increase appetite
  - Improve patient’s well being

Progressive ambulation
- Progressive lower extremities dependency with bedside sitting
- May use tilt table
  - Passive standing with totally support then partially support
  - provide gradual weight bearing
  - treatment for orthostatic hypotension

Progressive ambulation
- Elastic bandage wrapping prior to ambulation to decrease venous stasis and blood pooling
- Use extrapadding dressing or padded slipper in burn on sole of foot
- Use gait aid to protect, reduce pain or assist weight bearing

Contraindication for early ambulation
- Early massive edema of L/Es
- Exposed large tendons: Achilles tendon, Tibialis anterior tendon
Rehabilitation in post skin graft phase

- It is crucial to obtain full ROM before grafting
- Need to immobilized 5-7 days after grafting
- Proper positioning
- Maintain ROM of unaffected part
- Isometric exercise of affected part

Rehabilitation in convalescent phase

- Extend from the time of graft adherence or wound closure until scar maturation

Rehabilitation in convalescent phase

- Goal
  - Control edema
  - Decrease fibrosis & adhesion
  - Increase ROM, strength and endurance
  - Maximize independent functioning
  - Control scar
  - Provide education for skin care
  - Treatment burn scar contracture

Control edema

- Elastic bandage wrap / coban wrap
- Massage
- Functional movement

Elastic bandage / coban wrap, massage

- Massage to freeing restrictive fibrous band
- Greater rotatory motion along the scar
- Cocoa butter cream applied before
- Do 2-4 times/day
- Heat application: H/P, paraffin, U/S

Decrease fibrosis and adhesion
Exercise to increase ROM

- Evaluate total ROM across several joints
- Active exercise with terminal stretching
- Prolonged stretching may be needed
  - slurred sustained stretch is the most effective method

Exercise to increase strength and endurance

- Progressive resistive exercise
  - from manual resistance towards the use of weight and resistive tubing
  - concentrated on areas of weakness and muscles opposing scar tissue contracture

Strength and endurance training

Maximize independent functioning

- Encourage ADL
- Use adaptive devices
- Progressive ambulation
  - walk further with the least amount of support
  - correct abnormal gait

Control scar

- Hypertrophic scar: collagen arranged in random orientation with whorls and nodules

Hypertrophic scar

- Pathogenesis:
  - overzealous inflammation
  - prolonged re-epithelialization
  - overabundant extracellular matrix & collagen production
  - increase neovascularization
Hypertrophic scar

- Generally develop between 2-6 months after DPT and FT burn (8-12 weeks after wound closure)
- Increased level between 6-12 months
- Regress during maturation phase, 18-24 months
- More prevalent in areas of high skin tension: chest wall, shoulders and upper arm

Factors predispose to development of hypertrophic scar
- Depth of burn, healing time, grafting and skin character
- Race, age, genetics, immunological response

Scar assessment

- Vancouver Scar Scale (VSS)
  - Vascularity, pigmentation, pliability and height
  - It's subjective, not accurate describe, not known which area
- U/S scanning: thickness of scar
- VDO camera: color of scar
- Laser Doppler Flowmetry: perfusion of scar

To control and treatment scar

- Mechanical pressure:
  - Facilitate alignment of collagen fibers in more parallel, normal orientation
  - Decrease blood flow and O2 to rapidly metabolizing collagenous tissue
- Pressure 25 mmHg, at least 23 hrs./day

Vancouver Scar Scale

To control & treatment scar

- Mechanical pressure
  - Start when the wounds are almost or completely closed
  - Early form: elastic bandage, conforming thermoplastic along with bandage
  - May utilize tubular elastic bandage "Tubigrip", Coban, prefabricated pressure garment, custom-made garment
- Use pressure garment until scar mature; 18-24 months
To control & treatment scar

- Inserts
  - adjunced to achieve effective pressure over certain anatomical location where pressure garments do not provide adequate pressure: concave body area; face, neck, palm, web space, antecubital area
  - silicone gel, elastomer, thermoplastic

To control & treatment scar

- Scar massage
  - aids in softening or remodeling scar tissue by freeing adhering fibrous bands, allowing the scar to become more elastic and stretchy

To control & treatment scar

- Pulse dye LASER
  - cause photothermolysis
  - is absorbed by hemoglobin leading to coagulation necrosis → tissue hypoxia → decrease the number and proliferation of fibroblast → collagen fibers realignment & remodeling

Pressure garment and splint to control scar

To control & treatment scar

- Pulse Dye LASER in hypertrophic scar
  - flatten & decrease the volume of hypertrophic scar
  - improve texture, increase pliability and decrease erythema: usually seen after 2-3 treatment
  - can be used successfully in the early phase of wound healing and in established hypertrophic scar

Pulsed Dye LASER in hypertrophic scar
Skin care

- Skin problems
  - Skin dryness and fragile
  - Itching / pruritus
  - Sunlight and heat intolerance

Skin dryness and fragile

- Avoid prolonged water immersion
- Frequent apply mineral oil or cocoa butter or petroleum jelly / oiled-based lotion
- Apply lotion or oil before exercise

Itching/Pruritus

- Incidence 80 – 100 %
- Severe itching: 70 % in children, 50 % in adult
- Maximum during proliferative phase of wound healing

Severity depend on:
- burn area involved: burn area > 40 %
  - 100 % of leg burn
  - 70 % of arm burn
  - 0 % of face burn
- depth of burn: partial thickness greatest risk
- duration of time to wound closure: wound left open > 3 weeks very likely to hypertrophic scar & pruritus

Itching/pruritus

- Share the same neuronal pathway as pain
- Primary mediator is histamine
- Transmit by unmyelinated C-fibers
- Synapse in superficial laminae of dorsal horn of spinal cord
- Transmitted through anterolateral spinothalamic tract
- Supraspinal processing in anterior cingulate cortex

Itch pathway
Current treatment of burn pruritus

- Treatment pillars: antihistamine emollients

Antihistamine
- H1 receptor antagonists:
  - Diphenhydramine, hydroxyzine, cetirizine
  - Complete relief 20%, partial relief 60%, not relief 20%

Gabapentin
- Significant better than cetirizine
- Faster onset of action
- Combine: Gabapentin & antihistamine

Emollients
- Act to moisture & improve skin quality
  - Simple moisturizer: aloe vera, lanolin, liquid paraffin, coconut oil

Topical alternatives & adjuncts
- 5% Doxepin cream
- Doxepin is TCA with potent histamine receptor blocking properties, 50 times more potent than hydroxyzine, 800 times more potent than diphenhydramine

Non-medication treatment
- Pressure garment
- Massage
- TENS
- LASER
Sunlight and heat intolerance

- Avoid sun exposure
- Apply total sun block lotion before sunlight exposure

Treatment burn scar contracture

- Paraffin bath combined with sustained stretch:
  - Increase collagen extensibility
  - Make skin more pliable
- Ultrasound
- LASER

Treatment of burn scar contracture

- Splint
- Shoes modification or accommodation
- Assistive devices

Burn scar contracture

Special problems

Neuropathy after burn injury

- The most common is generalized peripheral neuropathy
- Peripheral neuropathy found about 18% of burn patient during acute hospitalization
- Not directly related to injured body region
- Associated with burn severity
- The most common sites were peroneal, ulnar, brachial plexus and median nerves
Neuropathy after burn injury

- Generalized peripheral neuropathy associated with severe burn may be caused by:
  - variant of critical care neuropathy
  - metabolic factors
  - medication used during burn treatment
  - neurotoxin
  - inflammatory cascade caused nerve dysfunction

Risk factors for development of neuropathy after burn

- Older age
- Burns >20% TBSA
- Length of hospitalization

Electrical injury

- Tissue of CNS, PNS, cardiac system and vascular sensitive to electrical injury
- Susceptible to neuropathy
- LMN disease has been reported: SCI, ALS onset weeks to years after injury
- Vulnerable to cardiac complications: cardiac arrhythmia was the most serious

Burn hand

Acute phase

- Edema in DPT and FT burn → classic burn hand deformity or claw hand
- Severe edema with limited ROM: use Kling roll to support transverse palmar arch, should not splinted
- Moderate edema with limited ROM → splint in safe position
- Transient edema in SPT, moderate edema in DPT & FT with nearly full ROM → no need for splint
Splint in acute phase

Splint in antideformity position

Burn hand

- After edema subsided
  - Splint in antideformity position
  - Circumferential burn:
    - safe position – daytime
    - palmar stretch – nighttime
  - Dorsal hand burn: palmar splint in safe position
  - Palmar hand burn: dorsal splint in full extension and abduction

Splinting

- May use dynamic splint to increase ROM in this phase

Dynamic splint

Active muscle pumping exercise

- Finger abduct/adduct
- Isolated MCP jt.flexion and isolated IP jt.flexion
- Composite finger flexion in SPT and DPT with no deep dorsal hand burn
- Avoid forced composite finger flexion in deep dorsal hand burn
**Active hand exercise**

- Exercise in DPT and FT at dorsum of hand
- Exposed central slip of extensor tendon at PIP jt.
- Ruptured central slip of extensor tendon

**Precaution for ROM exercise**

- Severe edema: avoid passive exercise
- DPT and FT burn at dorsum of hand
  - Avoid composite finger flexion
  - Monitor for extension lag
  - Appropriate exercise: MCP flexion with wrist and IPjts in extension
  - PIP flexion with wrist and MCPjts in extension

**Exercise in DPT and FT at dorsum of hand**

- Continuous splint PIP jt. in full extension, active ROM exercise of MCP and DIP jt.

**Exposed central slip of extensor tendon at PIP jt.**

- Continuous splint PIP jt. in full extension, active ROM exercise of MCP and DIP jt.

**Ruptured central slip of extensor tendon**

- Boutonnière deformity, can not actively extend PIP jt.
  - Continuous splint PIP jt. in full extension
  - 4-6 weeks

**Oro-facial burn**

- Wearing orthosis all night to preserve horizontal lip opening
- Massage and stretching of lip and jaw 4 times a day to avoid scar contracture
- Maintain circular distance of orbicularis oris muscle with 5 min. hourly stretching
Conclusion

In addition to burn injury, many forces and condition can contribute to loss of function and deformity. Treatment team must be knowledgeable of these forces and condition and must intervene appropriate and timely treatment. When combine with patient compliance, good outcome can be achieved.

Thank you