- If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.
- This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.

Technical issues with the Recording?

- Clear browser cache using these instructions
- Switch to another browser
- Use a hardwired Internet connection
- Restart your computer/device

Still having issues?

- Call 866-782-9924 (M-F, 8 AM-8 PM ET)
- Email customerservice@OccupationalTherapy.com

Acute Flaccid Myelitis: Overview of Treatment and Case Studies

(Part 2)

Kaitlin Hagen, MOT, OTR/L

Disclosures

- I, nor any member of my family, receive compensation, financial or otherwise, for any services or products discussed herein.

Learning Outcomes

At the conclusion of this webinar, participants will be able to:

- Define AFM and review current research
- Describe Activity-Based Rehabilitation (ABRT)
- Identify therapeutic techniques central to the practice of ABRT for AFM

What is Acute Flaccid Myelitis (AFM)?

Acute Flaccid Paralysis

- National surveillance for acute flaccid paralysis stopped in the USA after the eradication of Polio.
- California continued with passive surveillance and noted an increase in reports of acute flaccid paralysis in 2012 without an etiology. CA implemented increased surveillance.
- Canada and Europe continued with surveillance through the 1990s into the 2000s.

Acute Flaccid Myelitis Definition

Clinical Criteria: An illness with onset of acute flaccid limb weakness

Laboratory Criteria:

Confirmatory: a magnetic resonance image (MRI) showing spinal cord lesion largely restricted to gray matter and spanning one or more vertebral segments

Supportive: cerebrospinal fluid (CSF) with pleocytosis (white blood cell count >5 cells/mm3)

To confirm a case of AFM:

Confirmed:

Clinically compatible case AND Confirmatory laboratory evidence

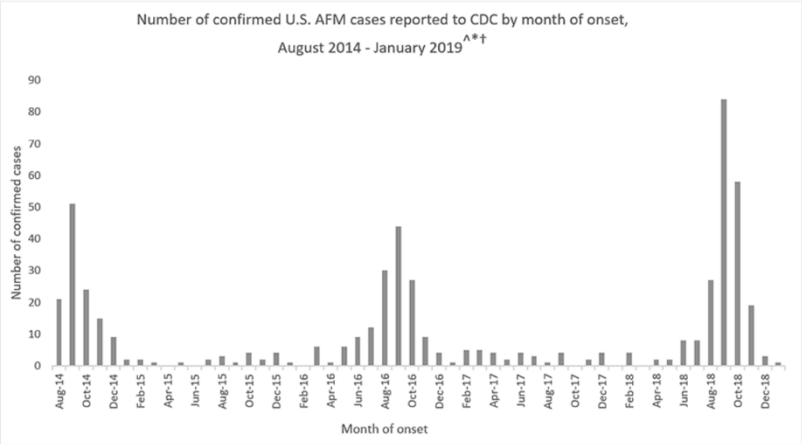
Probable:

Clinically compatible case AND Supportive laboratory evidence

Acute Flaccid Myelitis Definition

- Spinal cord lesions may not be present on initial MRI.
- A negative or normal MRI performed within the first 72 hours after onset of limb weakness does not rule out AFM. MRI studies performed 72 hours or more after onset should also be reviewed if available.
- Terms in the spinal cord MRI report such as “affecting mostly gray matter,” “affecting the anterior horn or anterior horn cells,” “affecting the central cord,” “anterior myelitis,” or “poliomyelitis” would all be consistent with this terminology.

Acute Flaccid Myelitis



Presentation of AFM

- Patient's with AFM range from presenting with monoplegia to tetraplegia on a vent (and everything in between)
- 5% acutely make full recovery
- 18% make a full recovery within 4 months
- We see the other 80% on rehab and will be focusing on those cases today
- To our knowledge there have been no relapses and it is not progressive

Ventilatory Support at KKI

- Extreme flaccidity, poor chest wall recoil, increased chest wall compliance, extremely prone to atelectasis.
- Out of 19 inpatient admissions (before 2018), 10 were requiring some degree of respiratory support on admission, and 9 were at discharge
- 8 of the initial 10 had decreased levels of support by time of discharge
- Looking closer at diaphragmatic pacers during the acute phase

CONTINUED

Ventilator Support at KKI

Type of Respiratory Support	Admission #	Discharge #
Ventilator 24 hours/day	7	4 (3 of these with decreased settings)
CPAP/BiPAP 24 hours/day	2	0
Vent at night / PAP during day	1	1
Vent at night / No support during day	0	2
PAP at night / No support during day	0	1
No support 24 hours/day	9	11
Total number with decreased respiratory support by time discharge		8 (80% of those with any respiratory support at time of admission).

CONTINUED

What have we seen in 2018

- Nearly 100% of our cases this year have required pharmacologic intervention for hypertension
  - Why the increase? Possibly younger average age; seeing sooner in course; different patterns of viruses??
- Increasing numbers of pathologic fractures being noted (often present on arrival to our hospital, so not all therapy-related)
- Have started routine referral to endocrinologist, DEXA scan, labs to evaluate for pamidronate therapy.

Rehabilitation of AFM using Activity Based Restorative Therapy (ABRT)

Habilitation

- Guiding children to an anticipated potential
  - Attain function and health as we know it, but at a level unknown to them
  - Children don't always understand the end goal as they have not completed the task before
  - Don't have prior learning and skills to fall back on
  - Goals always changing
  - Easy for them to fall behind their peers

Plasticity

- Very young children have immature brain and spine
  - Show better recovery
  - Continue recovery over many years
- May have undamaged areas of the nervous system masked by immaturity

Why Activity?

- "Regular Physical Activity throughout life is important for maintaining a healthy body. Nevertheless, 60% of the global population fails to achieve the minimum physical activity recommendations."
- "Persons with chronic physical condition are at greater risk due to inactivity than able-bodied persons because they are often restricted in performing normal everyday activity such as walking, housekeeping, gardening, shopping, and participating in sports."

van- den Berg-Emoms, Bussmann, Stam, (2010)

Activity Based Restorative Therapy (ABRT)

- 5 key components:
  - Functional Electrical Stimulation
  - Locomotor Training
  - Weight Bearing/Loading
  - Patterned Activity
  - Task-Specific Practice
- Plus
  - Aquatic Therapy
  - Vibration
  - Home based/community integration

ABRT in Very Young Children

- ABRT can be applied to children of all ages
- Key Factors:
  - Creativity
  - Family centered
  - Individualized treatment plans evolve as the child grows and achieves new milestones
    - There is more than one recipe for success
- Ultimate goal should be increased independence in mobility and function.

Functional Electrical Stimulation

TES	NMES	FES	TENS
Therapeutic Electrical Stimulation	Neuromuscular Electrical Stimulation	Functional Electrical Stimulation	Transcutaneous Electrical Nerve Stimulation
Use of electricity to drive a desired nerve response for therapy.	Electricity applied across the surface of the skin over intact peripheral nerve evokes an action potential in the nerve fiber which causes an exchange of ions to drive the muscle to contract.	Application of electrical stimulus to a paralyzed nerve or muscle to restore or achieve function. Also refers to orthotic substitution (Bioness L300).	Pain modulation by exciting peripheral nerves. Common Types: • Sensory • Motor • Noxious

Benefits of FES

- Increased bone mineral density
- Reduction of tone
- Orthotic substitution
- Improving blood flow and muscle health
  - Improve and maintain muscle mass during or following periods of inactivity
  - Maintain/Increase ROM
  - Re-educate/facilitate voluntary contraction
  - Reduce effects of spasticity

Clinical Applications of FES

- Combine with functional activities using portable e-stim unit (EMPI, Intellect)
- Orthotic substitution (Bioness L300 & H200, Walk Aide)
- FES cycling (upper and lower extremities- RT 300, MotoMed)
- Biofeedback (Neuromove, Myotrack Infiniti, Otto bock STIWELL med4)
- Swiss stimulation or 1ms program

Locomotor Training

- An activity-based rehabilitative strategy designed to improve sensory, motor and autonomic function, health and quality of life
- Provides sensory cues to re-train neural patterns that will result in effective locomotion
- Emphasizes recovery of motor function using the intrinsic mechanisms of the nervous system, rather than compensatory strategies

Traditional Locomotor Training

4 Principles of LT:

1. Maximize weight bearing on the legs
2. Optimize sensory cues
3. Optimize kinematics for each motor task
4. Maximize recovery; minimize compensation

3 Components to LT:

1. Treadmill training
2. Overground training
3. Community training

Weight Bearing/Loading

- UE weight bearing can be achieved through:
  - Seated prop
  - Quadruped
  - Prone positioning
- LE weight bearing can be achieved through:
  - Quadruped or tall kneel
  - Standing:
    - With or without assistance
    - With or without bracing- No or minimal bracing preferred
  - Supported standing in standing frame
    - Static stander
    - Dynamic stander
    - Stander with glider component

Clinical Applications of Weight Bearing

Patterned Activity

- Repetitive task specific and non-task specific activities
- Promote cortical reorganization
  - In CIMT, benefits result from frequency of use of involved side, not constraint of uninvolved side
- Repeated multiple times for multiple hours/days
- Improve strength and ROM
- Perfect practice makes perfect
- Incorporate other components
  - Principles of LT
  - FES

Unweight the arm

Task Specific Practice

- Practice of context specific motor tasks
- Training functional task rather than impairment
- Paired with feedback
- Goal directed
- Repetition
- Incorporate other components
  - Stand at sink to brush teeth
  - FES to ankle dorsiflexion during gait
  - High repetitions of elbow flexion followed by self-feeding

Application of Task-Specific Training

- Relevant: meaningful to patient, context specific
- Random: facilitates retention, transfer, generalizability
- Repetitive: practice assists in skill mastery
- Reconstruction: breakdown the task to identify component weaknesses and areas for improvement
- Reinforced: timely and positive feedback

Don't Let Bad Habits Persist

- Use it or lose it: Abhorrent patterns and compensatory strategies have to be overcome by rehabilitation
- Patients will figure out how to get things done (ex: tenodesis, one hand, toes, fingers)
- Cortical reorganization responds to non-use as much as therapy
- The body learns what we teach it
- Constraint Therapy

Vibration

- Side-alternating repetitive motion that simulates a (physiologically meaningful) movement pattern similar gait pattern
- Creates motor and neural learning effects by stimulating an involuntarily controlled "stretch-reflex" reaction that quickly and effectively improves existing residual functions and specific movement patterns
- Different settings help to decrease muscle tone or to help recruit nerves to fire

CONTINUED

Aquatics

- ABRT principles can be applied in the aquatic environment to facilitate weaker muscle groups and provide resistance against stronger muscle groups.
- Properties of water utilized:
  - Buoyancy
  - Viscosity
  - Turbulence
  - Hydrostatic Pressure
  - Warmth
- Examples of ABRT and aquatics
  - Locomotor training & partial body weight supported gait training
  - High repetition of reciprocal, patterned movement
  - Standing

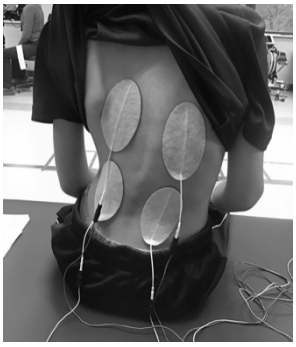
CONTINUED

Secondary Complications: Shoulder Subluxation

- Bracing
  - Goal: to keep the hand free and usable
- Electrical Stimulation
- Kinesiotape or leukotape
- Weight bearing
- Wheelchair set up

Secondary Complications: Scoliosis

- Electrical Stimulation
- Bracing (but strengthen)
- Weight bearing
- Alignment in wheelchair



The distal return can make positioning difficult as patient's can wiggle out of ideal positions, but not always get themselves back into them

Secondary Complications Hip Subluxation/Dislocation

- Weight bearing!!
- Ensure good alignment during activities
- Wheelchair set up

Secondary Complications: Fractures

- Be cautious of how you are moving the patient
- Our job to teach families to be careful, but to try not to scare them as it is important for them to keep their kids moving and active
- We know activity and weight bearing are important

Home Rehabilitation Program

- SCI/AFM requires a lifetime of care
- Incorporating the ABRT principles is key
- Prioritize the patient's impairments and functional limitations
- Consider building challenges into the environment

Common recommendations for equipment for home:

- Electrical stimulation unit
- Standing frame (mobile or glider)
- Wheelchair
- Bath equipment

Outcomes using ABRT on Inpatient Rehabilitation

KKI Inpatient Rehab Program

- PT 2-3 hours a day
- OT 1-2 hours a day
- SLP up to 1 hour a day
- BP, NP, SW, CL, TR, Respiratory Therapy, Nursing, Medical Team
- The children reviewed came to inpatient acutely or within a year of diagnosis
- Most were admitted for 6-12 week admission dependent on medical and rehabilitation needs
- Outcome measures utilized if age appropriate

Physical Ability and Mobility Scale (PAMs)

Also know as PAMS: scored 1-5

1. Tolerance to positioning
2. Tolerance to sitting in chair
3. Tolerance to orthoses or splint
4. Support for seating system
5. Head control
6. Trunk control
7. Rolling supine to/from prone
8. Transitioning from supine to sit
9. Transitioning from sit to stand
10. Standing

PAMs Continued

11. Transitioning from floor to stand
12. Environmental transfers
13. Transfers into and out of a car
14. Walking on level ground – assistive device
15. Walking on level ground – distance
16. Walking on level ground – level of assistance
17. Community skills
18. Wheelchair mobility
19. Standing balance
20. Stairs

Outcome Measures- Admission to Discharge

	Admission		Discharge			
	M	SD	M	SD	t-test	*d*
SCIM (n=18)	31.1	26.4	51.3	29.0	-3.91***	-0.92
PAMS (n=27)	49.7	22.4	67.3	20.5	-7.21***	-1.39
WeeFIM® Self-Care DQ (n=29)	46.3	24.1	62.7	24.7	-5.54***	-1.03
WeeFIM® Mobility DQ (n=29)	39.7	26.9	57.0	23.6	-5.71***	-1.06
WeeFIM® Cognitive DQ (n=26)	85.3	36.5	97.6	54.0	-2.18*	-0.43
WeeFIM® TOTAL DQ (n=16)	54.0	24.3	70.1	25.8	-11.87***	-1.54

*p<.05, **p<.01, ***p<.001

Outcome Measures Results

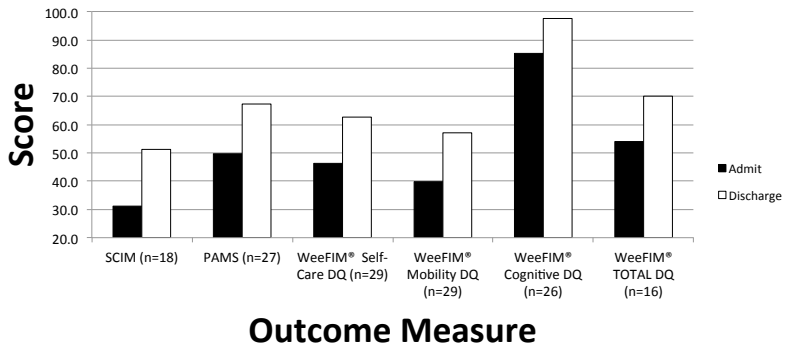
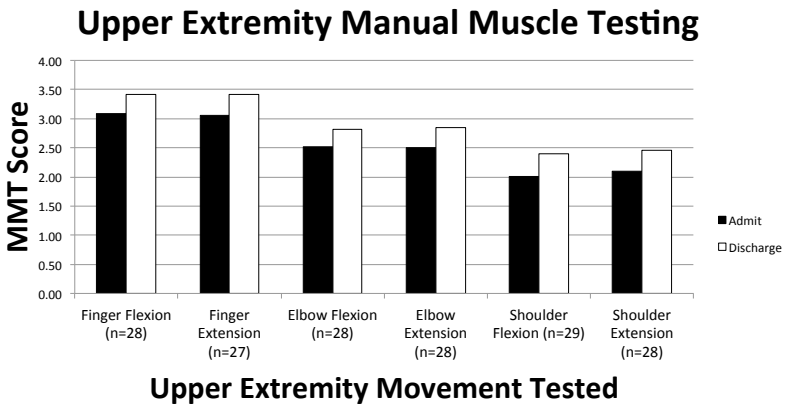
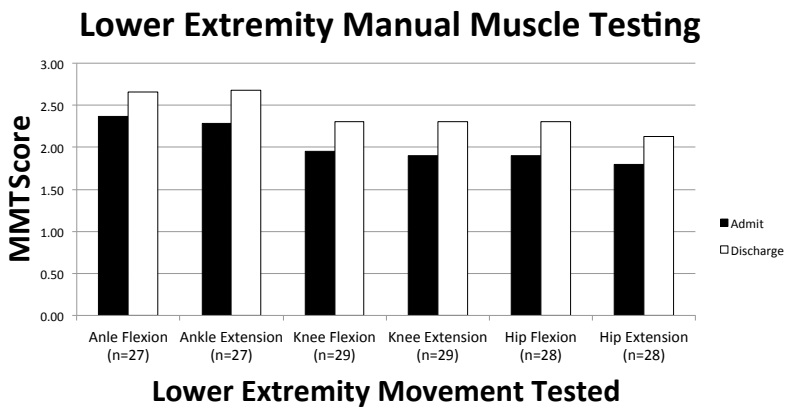


Table 3: Change from Inpatient Admission to Discharge on MMT by muscle group

	Admission		Discharge			
	M	SD	M	SD	t-test	*d*
Ankle Flexion (n=27)	2.37	1.50	2.66	1.65	-2.46*	-0.47
Ankle Extension (n=27)	2.28	1.53	2.68	1.74	-2.90**	-0.56
Knee Flexion (n=29)	1.95	1.60	2.30	1.64	-4.10***	-0.76
Knee Extension (n=29)	1.90	1.60	2.30	1.60	-2.63*	-0.49
Hip Flexion (n=28)	1.90	1.60	2.30	1.50	-3.14**	-0.59
Hip Extension (n=28)	1.80	1.53	2.13	1.46	-3.17**	-0.60
Finger Flexion (n=28)	3.09	1.70	3.41	1.50	-3.17**	-0.60
Finger Extension (n=27)	3.06	1.69	3.42	1.40	-3.35**	-0.64
Elbow Flexion (n=28)	2.52	1.69	2.81	1.70	-4.53***	-0.86
Elbow Extension (n=28)	2.50	1.72	2.85	1.75	-3.76***	-0.71
Shoulder Flexion (n=29)	2.01	1.56	2.40	1.73	-3.24**	-0.60
Shoulder Extension (n=28)	2.10	1.66	2.45	1.65	-3.55***	-0.67

*p<.05, **p<.01, ***p<.001




Lower Extremity Manual Muscle Testing
MMTScore
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Anle Flexion (n=27)
Ankle Extension (n=27)
Knee Flexion (n=29)
Knee Extension (n=29)
Hip Flexion (n=28)
Hip Extension (n=28)
Admit
Discharge
Lower Extremity Movement Tested

Case Study

Case Study: JG

	2016 admit	2016 Discharge	2017
Head Control	None	Activates cervical ROM with support at occiput	Activates cervical ROM with support at occiput (stronger)
Upper Extremity Status	No AROM	Gravity eliminated bilaterally in digits, no AROM otherwise	Improved digit strength and emerging digit 1 twitches in right hand
Lower Extremity Status	No AROM	Against gravity at knee and ankle, twitch hamstrings and glutes	Against gravity at knee, ankle, hamstrings, and glutes (hip gravity eliminated)
W/C	Dependent tilt-in-space	Proportional control power mobility using a foot joystick placed on left foot plate	Proportional control power mobility using a foot joystick placed on left foot plate (community distance)
Ability to eat	NPO	Trials with therapy only	Cleared to eat with family, tolerates small trials
PAMS	24	38	44

Head Control

Head Control Today?!

Digit Progression

Lower Extremity Progression

Sit to Stands

Independent Mobility: return to school

AFM Summary

- AFM is similar to polio in epidemiology, pathophysiology and presentation.
- Presentation can be variable with wide spectrum of impairments.
- Recovery possible but can be slow
- It can be good to take breaks from therapy and let the child be a kid.

AFM Summary

- There is limited knowledge regarding long term outcomes.
- It is important to maximize function and participate in ABRT for secondary health benefits.
- Strong coordination with outpatient plans for these kids to prevent chronic complications such as contractures, scoliosis, anxiety, and decreased community reintegration.

References:

Messacar, K., Schreiner, T. L., Van Haren, K., Yang, M., Glaser, C. A., Tyler, K. L., & Dominguez, S. R. (2016). Acute Flaccid Myelitis: A Clinical Review of US Cases 2012-2015. Annals of Neurology.

Case Definitions. (2016, January 22). Retrieved May 14, 2018, from http://www.cdc.gov/acute-flaccid-myelitis/hcp/case-definition.html

AFM in the United States. (2016, December 01). Retrieved May 14, 2018, from http://www.cdc.gov/acute-flaccid-myelitis/afm-surveillance.html

Van Haren, K., Ayscue, P., Waubant, E., Clayton, A., Sheriff, H., Yagi, S., ... & Wadford, D. A. (2015). Acute flaccid myelitis of unknown etiology in California, 2012-2015. JAMA, 314(24), 2663-2671.

Maloney, J. A., Mirsky, D. M., Messacar, K., Dominguez, S. R., Schreiner, T., & Stence, N. V. (2015). MRI findings in children with acute flaccid paralysis and cranial nerve dysfunction occurring during the 2014 enterovirus D68 outbreak. American Journal of Neuroradiology, 36(2), 245-250.

Sejvar JJ, Lopez AS, Cortese MS, Leshem E, Pastula DM, Miller L, Glaser C, Kambhampati A, Shioda K, Aliabadi N. Acute Flaccid Myelitis in the United States, August–December 2014: Results of Nationwide Surveillance *Clinical Infectious Diseases*, 2016, 63(6), 737–745.

Rybczynski S, Dean J, Melicosta M. Pediatric Spinal Cord Injury Due to Acute Flaccid Myelitis: Epidemiology, Clinical Management, and Implications for Rehabilitation. Curr Phys Med Rehabil Report (2017), 5:113-120.

Gordon-Likin E, Munoz L, Klein JL, Dean J, Izbudak I, Pardo C. Comparative quantitative clinica, neuroimaging, and functional profiles in children with acute flaccid myelitis at acute and convalescent stages of disease. Dev Med and Child Neuro. (2018), *published online.*

Johnston T.E., Modlesky C.M., Betz R.R., Lauer R.T. (2011). Muscle changes following cycling and/or electrical stimulation in pediatric spinal cord injury. *Archives of Physical Medicine and Rehabilitation*. 92:1937-1943.

Sadowsky, C.L., Becker, D., Bosques, G., Dean, J.M., McDonald, J.W., Recio, A., Frohman, E.M. (2011). Rehabilitation in Transverse Myelitis. *Continuum: Lifelong Learning in Neurology*. 17 (4), 816-830.

Schottler J, Vogel LC, Sturm P (2012). Spinal cord injury in young children: a review of children injured at 5 years of age and younger. *Developmental Medicine & Child Neurology*. 54:1138-1143.

Tefft, D. Guerette, P. Furumasu, J (2011). The impact of early powered mobility on parental stress, negative emotions, and family social interactions. *Physical and Occupational Therapy in Pediatrics.* 31(1):4-15.

CONTINUED

Questions?

- Hagenk@kennedykrieger.org