

# Current and Future Interventions for Chronic Pediatric Pain

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# Disclosures

- Consultant for Juris Medicus
- Spine & Surgical Hospital Board

# OBJECTIVES

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- Recognition of Chronic Pediatric Pain
- Identify Multimodal Approach for addressing Pediatric pain
- Incorporate Physical Therapy Modalities
- Appropriate use of Pharmacological tools to prevent and treat Chronic pediatric pain
- Role of Interventions



# Chronic Benign Pediatric Pain

- Continuous or recurrent pain with unknown etiology <sup>1</sup> (Perquin 2000 . Pain)
- Persistent for > 3 months
- Most common (15-20%):
- 1-HA, recurrent
- 2-Abdominal pain (RAP),
- 3- MSK as juvenile fibromyalgia (JFM)
- Significant socioeconomic burden <sup>2</sup>(Friedrichsdorf 2016)
- Predisposing factors: child's and parents' psychology, school/teacher/peer interactions



# Chronic pain in children may result from multiple etiologies

- I. Recurrent pain syndromes (e.g., headache and recurrent abdominal pain)
- II. Medical illnesses (e.g. juvenile arthritis and sickle cell disease)
- III. Neuropathic pain (including CRPS)
- IV. Cancer and/or its treatment



# MULTIDISCIPLINARY TEAMS

- Physicians (primary care physicians, pain physicians, psychiatrists)
- Non-physicians (psychologists, physical therapists, complementary therapists)
- Children and their parents to participate in all for positive reinforcement
- Multidisciplinary biopsychosocial rehabilitation and functional restoration approach



Hechler, T.; Ruhe, A.K.; Schmidt, P.; Hirsch, J.; Wager, J.; Dobe, M.; Krummenauer, F.; Zernikow, B. Inpatient-based intensive interdisciplinary pain treatment for highly impaired children with severe chronic pain: Randomized controlled trial of efficacy and economic effects. *Pain* 2014, 155, 118–128.

# MULTIDISCIPLINARY APPROACH

I - PHYSICAL THERAPY MODALITIES

II- BEHAVIORAL APPROACHES

III- Mind-Body Modalities and Integrative Medicine

IV- PHARMACOLOGICAL APPROACHES

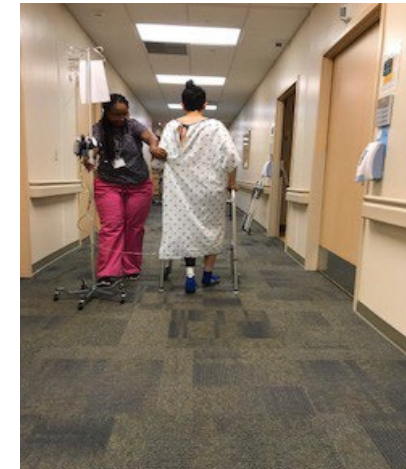
V- Interventional Modalities



# PHYSICAL THERAPY MODALITIES

- Rehabilitative programs demonstrated rapid decrease in pain and restoration function
- Restoring activity and returning to normal regimen of physical activity
- Return to sports/extra-curricular activities where social contacts occur,
- **Sports** and **School** attendance need to normalize
- Role of Aquatic therapy

Odell, S.; Logan, D.E. Pediatric pain management: The multidisciplinary approach. J. Pain Res. 2013, 6, 785–790.



## **Canadian Pediatric Society: Best practices in pain assessment and management for children (Nov. 2022)**

- Included 34 pharmacological (4091 participants), 25 physical therapy (1470 participants), and 63 psychological trials (5025 participants).
- Pharmacological, physical, and psychological therapies showed some benefit for reducing pain, posttreatment, but only physical and psychological therapies improved physical functioning
- The largest evidence base for the management of chronic pain in children supports the use of psychological therapies, followed by pharmacological and physical therapies. However, we rated most outcomes as low or very low certainty

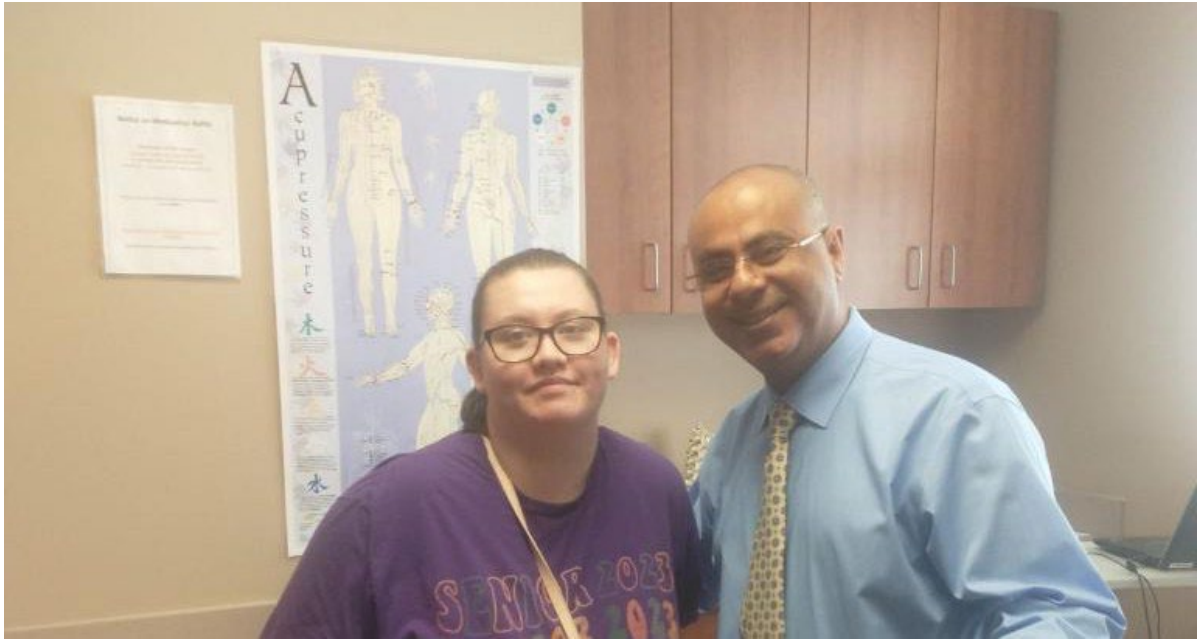
Trottier, E. D., Ali, S., Doré-Bergeron, M.-J., Chauvin-Kimoff, L., & Canadian Paediatric Society, Acute Care Committee, Hospital Paediatrics Section, Paediatric Emergency Medicine Section. (2022). Best practices in pain assessment and management for children. *Paediatrics & Child Health*, 27(7), 429–437.  
<https://doi.org/10.1093/pch/pxac061>

# PHARMACOLOGICAL APPROACHES :

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1. NMDA Receptor Antagonists
  - a) Ketamine nasal spray (Ferguson, 2020)
  - b) Dextromethorphan
2. Basic Analgesics
3. Adjuvant Analgesics
  - a) Gabapentinoids
  - b) Tricyclic antidepressants (low-dose amitriptyline ) (11)
  - c) Lidocaine 5% patch
  - d) Melatonin treatment of chronic pain (12)
  - e) Benzo and muscle relaxants
4. Antidepressants
  - a) SSRI (such as citalopram, sertraline, escitalopram) although little evidence
  - b) SNRI (Duloxetine) Efficacy studies in pediatric pain patients are lacking
5. Opioids
  - a) Should not be administered to patients with primary pain disorders (13 Schechter)





# Interventions

- Fluoroscopically guided continuous epidural catheters
- Botox injections
- Peripheral Nerve Stimulation
- Dorsal Root Ganglion Stimulation
- Virtual Reality



**ASRA** 17th Annual Pain Medicine Meeting  
November 15-17, 2018 | San Antonio, Texas | #ASRAfall18

<sup>1</sup>Anesthesiology, San Antonio, Tx. <sup>2</sup>Neuroscience Major, UT Dallas, Dallas , Tx. <sup>3</sup>UT Health Anesthesiology, San Antonio, Tx



Complex regional pain syndrome types (CRPS) I and II in children is not well studied in comparison to adults and could be incapacitating causing if not early recognized and treated. Pain-reducing procedures facilitate participation in a multidisciplinary program particularly with physical therapy to be instituted early, behavioral therapy and pharmacological therapy. Epidural catheters placed with X ray guidance can achieve a sympathetic and sensory blockade for extensive inpatient therapy where the family participates is preferred over repeated single block.

We reviewed charts of children (from our clinic and institution who waived IRB) below 18 years with the diagnosis of CRPS I& II from 2008- 2018. Data included pain scores before and after interventions, symptom duration, medications tried, rehabilitation modalities, investigations done, extremities involved and duration of epidural infusion. Children that underwent continuous epidural blocks under fluoroscopic guidance to place the catheter in the lateral gutter epidural space towards the nerve roots of the dermatomal distribution of involved extremity to deliver an infusion of 0.2% Ropivacaine at 2-6 ml/hour to achieve a selective sensory block with no motor weakness of the involved area as depicted by the spread of contrast dye with intermittent bolusing of 2 ml/20 minutes during inpatient rehabilitation.

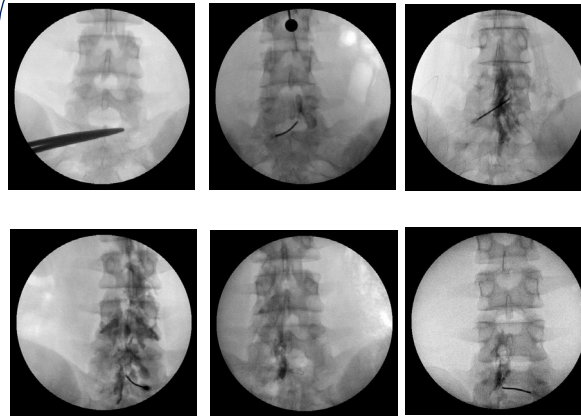


Figure 1: Placing continuous epidural blocks under fluoroscopic guidance. First by locating correct epidural space with epidural needle. Insertion of catheter followed by showing the spread of contrast medium.

Post procedure evaluation performed to confirm sensory blockade of the affected extremity with immediate participation in rehabilitation and education to the family for continuous desensitization while not participating with the therapists with daily monitoring of pain scores and restoration of functionality. Children were discharged with catheter in situ after 3 to 4 days of infusion and followed in clinic to evaluate if further boluses were required for outpatient physical therapy for another week. The catheters were removed after resolution of the symptoms and restoration of functionality.



Figure 2: Patients undergoing inpatient rehabilitation following placement of continuous epidural blocks.

From the children diagnosed with CRPS (70) 50% underwent vertebroplasty or kyphoplasty (CRAS1070) day 50 for the lowest extremity infarction while 10 % 10 weeks for upper lower extremity and 10% of which all Gender involvement was similar and both hips equally represented in fracture The age ranged from 8 to 16 years old with a median ages ranged from 3 to 10 months old. While there was a 15% relapse rate in month to 3 years. There was a 15% relapse rate requiring reoperation within 10 days but eventually repeated while 85% required completely totally resolved procedure 85% followed completely after the initial procedure followed for a year.

In our institution fluoroscopic guided placement of the epidural catheter enabled children with resistant CRPS to participate with in patient rehabilitation with active involvement of their families which promoted bonding and positive reinforcement between the children and their parents boosting their morale to success of therapy acting in some way as behavioral therapy after failure of conservative measures as the infusion was targeted to specific dermatomal distribution with fluoroscopic guidance which might have played a role in the neuroplasticity of the peripheral and central nervous system in cases with CRPS hence restoration of functionality and return to normal activity and school sports was achieved within a short period of time with very low rates of recurrence.

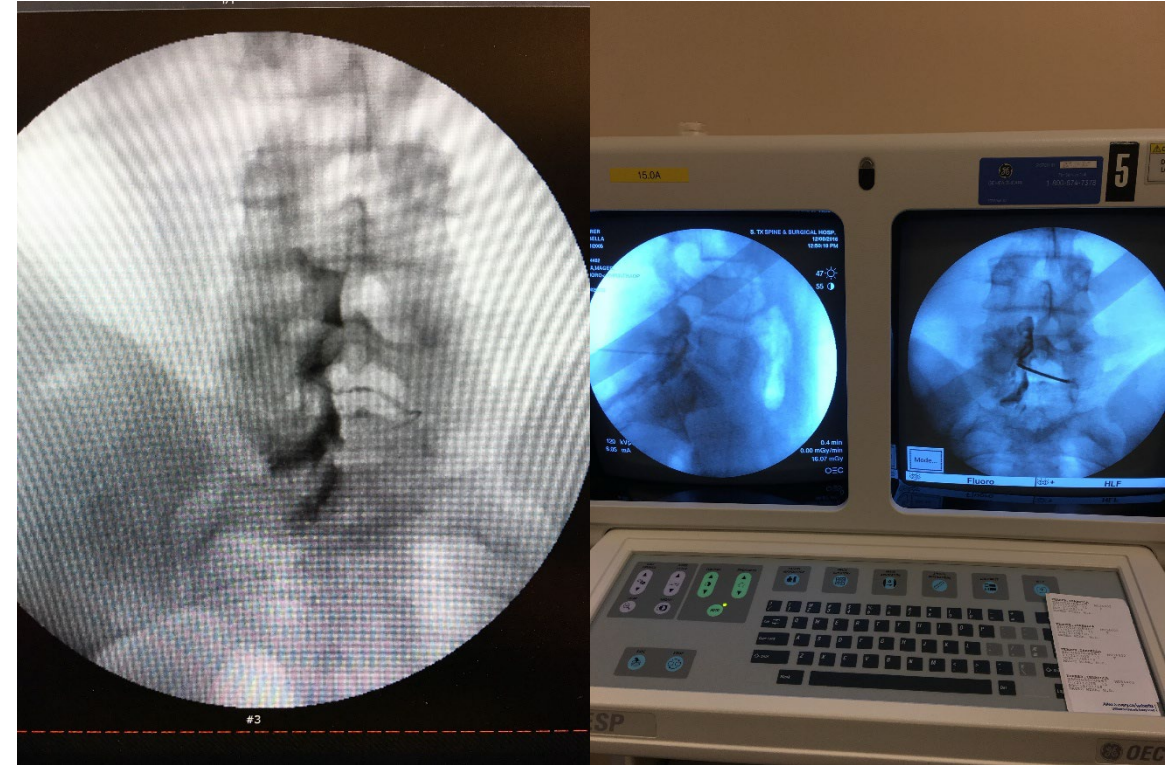
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## Acknowledgements

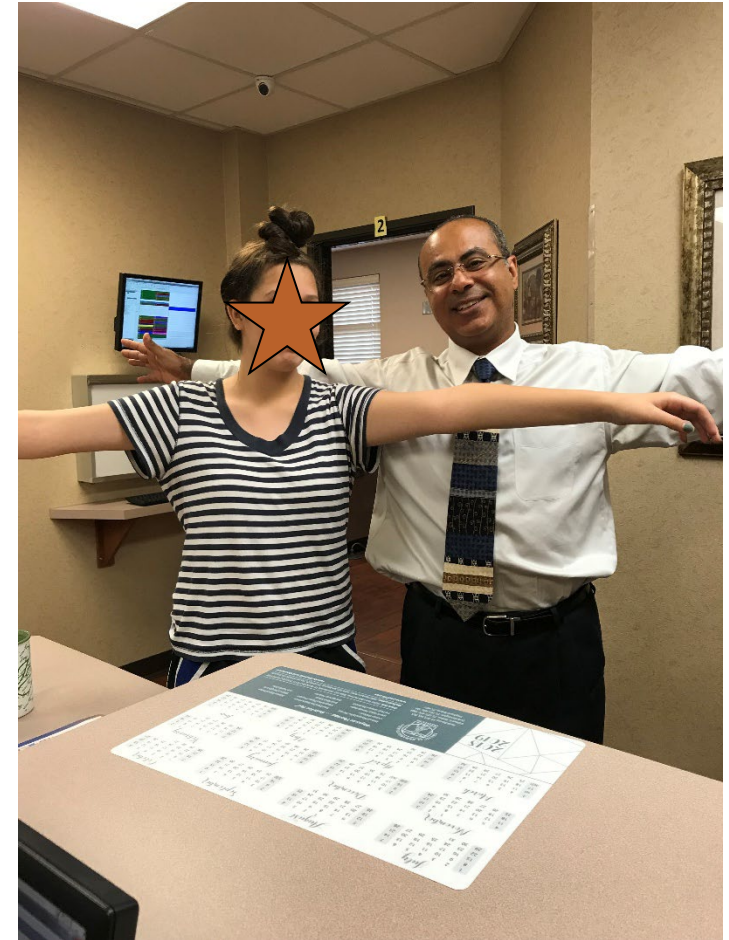
# Fluoroscopically guided epidural catheters

- Retrospective review 2008-2018
- (70) 50% epidural infusions lasting 4-10 days
- LE in 90% vs 10 % UE/thoracic
- Gender was even,
- Hispanics about third.
- Ages :3 -16 years old
- Symptom from 1 month to 3 years.
- 15% relapse rate in our population within 1-3 years requiring repeating the procedure but eventually recovered
- 85% recovered completely after the initial procedure followed for a year.



# Injectons for Pediatric Headaches

- Botox for Prophylactic Treatment of Pediatric Migraine ( Shah 2021)
- The Efficacy of Botulinum Toxin in Pediatric Chronic Migraine: (Marcelo 2020)
- Greater occipital nerve blocks . Son. Ann Child Neurol 2021



- Shah S, Calderon M, Crain N, *et al* Effectiveness of onabotulinumtoxinA (BOTOX) in pediatric patients experiencing migraines: a randomized, double-blinded, placebo-controlled crossover study in the pediatric pain population *Regional Anesthesia & Pain Medicine* 2021;46:41-48.
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# Peripheral Nerve Stimulation

- Historically, procedure was limited by greater mechanical stresses on the leads leading to greater risk of lead migration or disruption
- Recent advancements have focused on targeting large diameter afferent sensory nerves at a frequency of 100 Hz or efferent fibers at a frequency of 12 Hz
- Frequencies of 100 Hz can induce comfortable sensations while frequencies of 12 Hz can induce contractions in muscles to induce comfort

# Peripheral Nerve Stimulation

- Elimination of invasive methods to reduce nerve exposure replaced with percutaneous implantation of conventional PNS leads
- Ultrasound imaging guidance for lead placement
- Improvement in secure electrode placement and lowered infection rate with use of open coil leads with axial flexibility
- Percutaneous PNS can offer temporary pain relief (up to 60 days) at minimum to one year after treatment

# Peripheral Nerve Stimulation

- Open coil leads can be placed at a distance to target large diameter A $\alpha$ / $\beta$  fibers sparing small diameter C or myelinated A $\delta$  fibers
- Activation thresholds are lower in large diameter fibers compared to small diameter fibers
- Sustained pain relief related to plasticity of the CNS
- Peripherally Induced Reconditioning of the CNS
- Unclear if this reconditioning reverses to the state prior to pain or if a new equilibrium is achieved
- No current pediatric RCT but mostly case reports .

# Dorsal Root Ganglion Stimulation (DRG)

- ACCURATE trial established that patients achieved greater than 50% reduction in pain with dorsal root ganglion stimulation device implantation versus traditional spinal cord stimulation (SCS)
- Device can be adjusted over time to minimize paresthesia and to maintain pain relief
- Prior treatment with SCS does not exclude future treatment with DRG stimulation so it is an encouraging treatment option for those who have developed tolerance to or failed SCS
- FDA approval for DRG stimulation achieved in 2016 for treatment of CRPS type I and II in adults and can be promising for pediatric patients

Pinckard-Dover H., Palmer A., Petersen E.A. 2021. A Review of Neuromodulation for Treatment of Complex Regional Pain Syndrome in Pediatric Patients and Novel Use of Dorsal Root Ganglion Stimulation in an Adolescent Patient With 30-Month Follow-Up. *Neuromodulation* 2021; 24: 634–638

Mekhail N, Deer TR, Kramer J, et al. Paresthesia-Free Dorsal Root Ganglion Stimulation: An ACCURATE Study Sub-Analysis. *Neuromodulation*. 2020;23(2):185-195.

# Dorsal Root Ganglion Stimulation (DRG)

- No previous trials have been conducted analyzing the effect of DRG stimulation in pediatric patients and recent evidence is provided by pediatric case reports
- First reported case study is of a pediatric patient with CRPS treated with DRG stimulation with maintained benefit at 30 months
- DRG stimulation can provide greater specificity of stimulation with less variation in intensity to target areas of pain
  - Mechanism remains unclear but a working theory is stimulation suppresses activity of C-type nerve fibers leading to a block of nociceptive signals

# Virtual Reality Therapy

- Can be an avenue to treat pain using distraction or increased engagement with use of a VR headset
- Offered the opportunity to exchange the child's experience in their physical reality to what they perceive virtually
- Transforming and interactive nature of Virtual Reality especially useful in the pediatric population to improve activity level and mobility without complaint of pain

Won AS, Tataru CA, Cojocaru CM, et al. Two Virtual Reality Pilot Studies for the Treatment of Pediatric CRPS. *Pain Med* 2015;16(8):1644-1647.

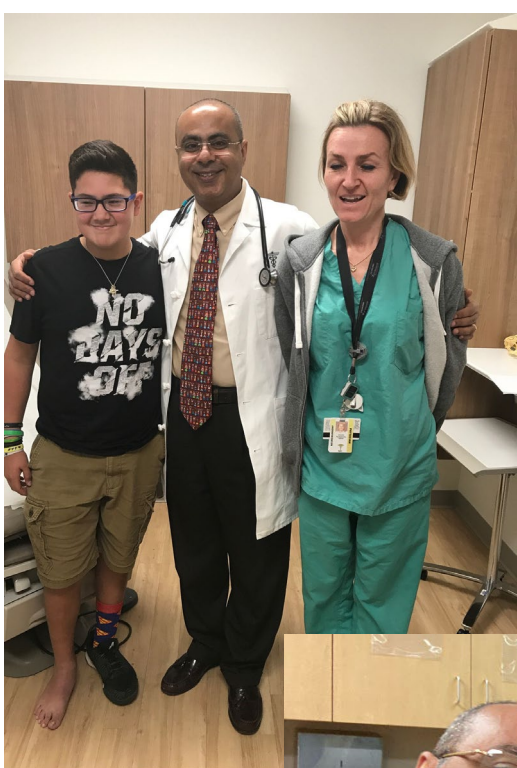
Won AS, Bailey J, Bailenson J, Tataru C, Yoon IA, Golianu B. Immersive Virtual Reality for Pediatric Pain. *Children (Basel)*. 2017;4(7):52. Published 2017 Jun 23.

# Virtual Reality Therapy

- Virtual reality therapy replaces the sensory information from the real world and makes use of avatar bodies for patients to respond to physical tasks and targets
- Allows the patient to perceive the avatar's movements and body mechanics as their own allowing for greater range in therapy
- It is well-tolerated and with VR technology being progressively introduced commercially, it can be more readily available at home for continued therapy

Won AS, Tataru CA, Cojocaru CM, et al. Two Virtual Reality Pilot Studies for the Treatment of Pediatric CRPS. *Pain Med* 2015;16(8):1644-1647.

Won AS, Bailey J, Bailenson J, Tataru C, Yoon IA, Golianu B. Immersive Virtual Reality for Pediatric Pain. *Children (Basel)*. 2017;4(7):52. Published 2017 Jun 23.



TEAMWORK



# Family Support

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