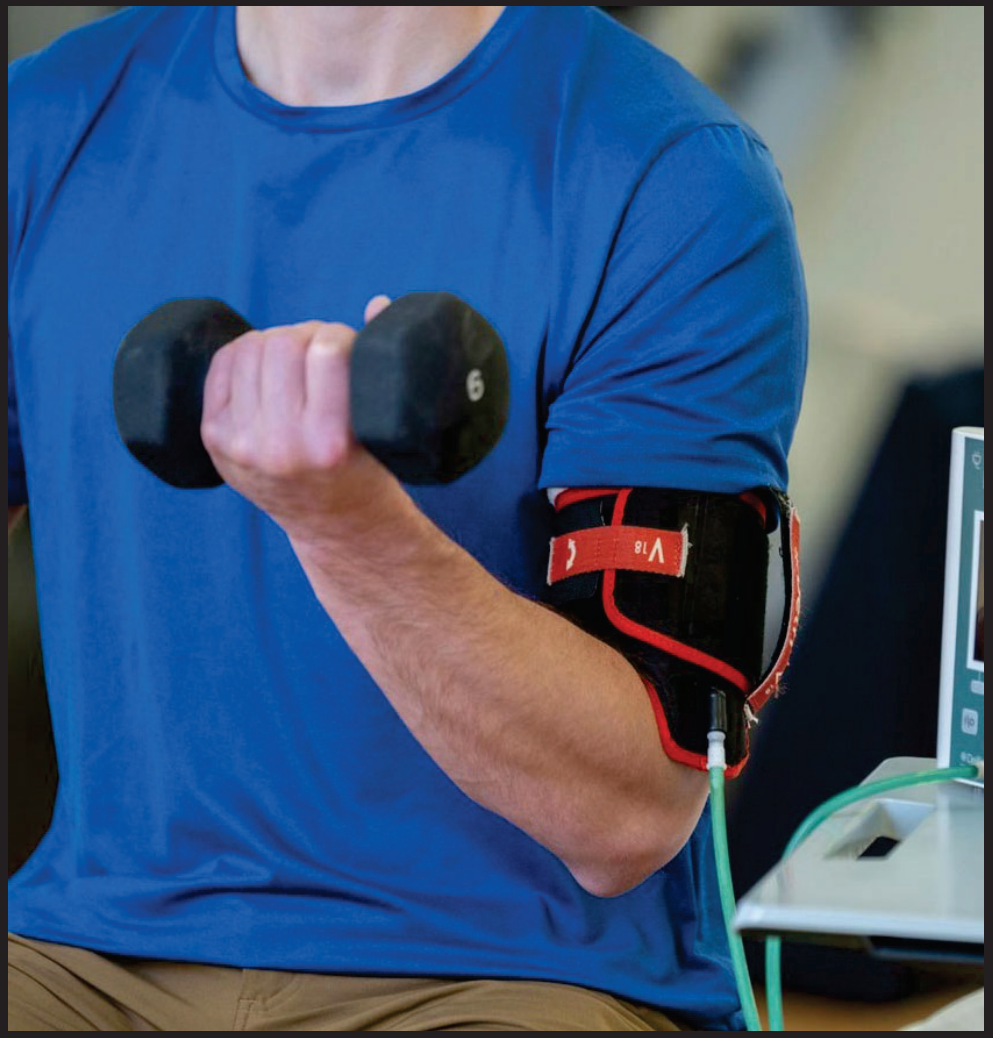

# ADVANCED TECHNIQUES IN REHABILITATION: BLOOD FLOW RESTRICTION AND CONCUSSION MANAGEMENT

# IMPLEMENTING BLOOD FLOW RESTRICTION IN CONCUSSION AND DYSAUTONOMIA REHABILITATION

- Understand the principles and physiological effects of blood flow restriction (BFR) therapy
- Explore the application of BFR in rehabilitation settings, particularly for muscle strengthening and recovery
- Gain insights into the pathophysiology of concussions and their impact on the nervous system
- Learn about the integration of BFR therapy in managing post-concussion symptoms
- Discuss case studies and clinical evidence supporting the use of BFR and concussion rehabilitation strategies

Blood Flow Restriction Training (BFR) is a training technique that involves partially restricting blood flow to the working muscles during exercise. This technique has been found to be effective in promoting muscle growth and strength gains, even with lighter loads, making it a valuable tool in rehabilitation settings.

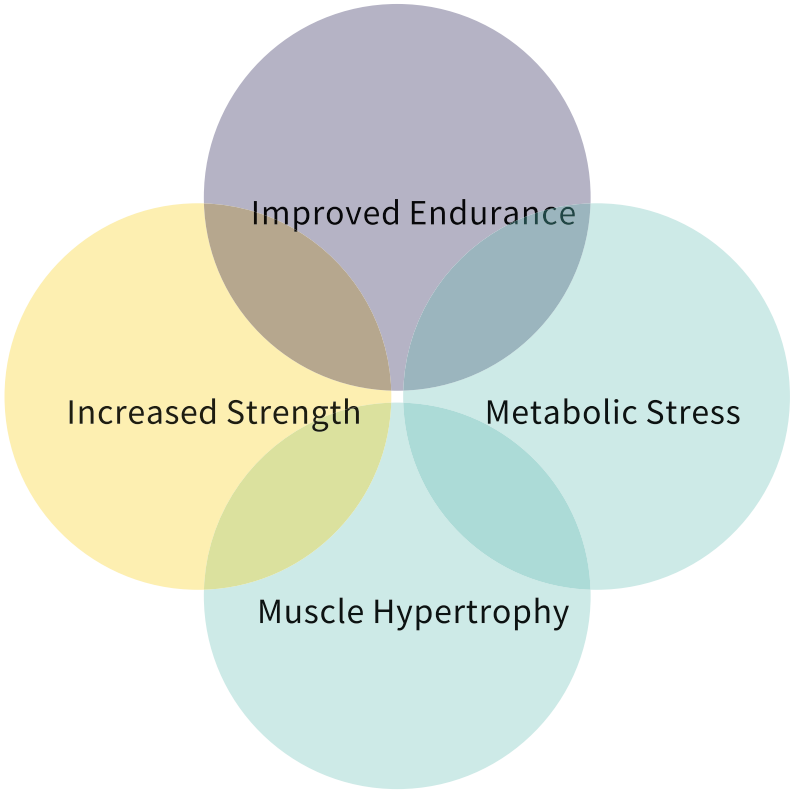


1. Have Patient Relax and place cuff over target limb
2. Bladder facing inner side of limb.
3. Begin Cuff Inflation

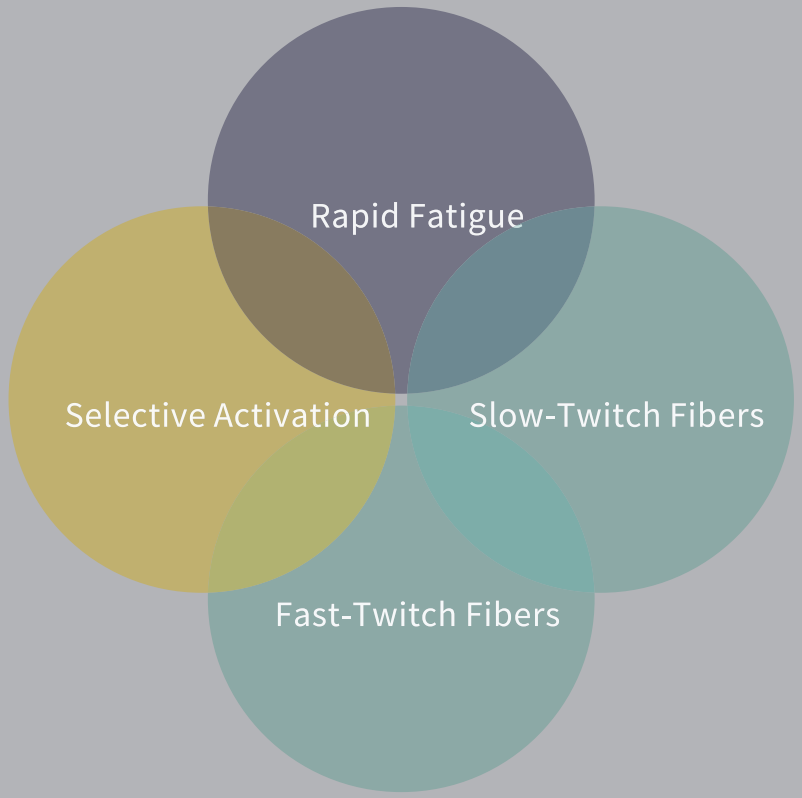
   Cuff will inflate automatically in case of auto systems.
4. Full Venous and Arterial Occlusion Established

   Automatiic systems will do this for you
5. Take note of value in mmHg

# EFFECTS OF BLOOD FLOW RESTRICTION



# EFFECTS ON MUSCLE FIBERS



# GLOSSARY OF TERMS

### Anabolic Hormones

Hormones like growth hormone (GH) and insulin-like growth factor-1 (IGF-1) that promote tissue growth and repair. BFR training can increase the release of these hormones.

### Ischemia

The temporary restriction of blood flow to a specific area, which occurs during BFR training when the cuff is applied and pressure is increased.

### Hypoxia

A state of reduced oxygen availability in tissues, which is induced locally by BFR, leading to various physiological responses.

### Myokines

Small proteins released by muscle cells during exercise, which have numerous positive effects on muscle growth, metabolism, and overall health. BFR training can increase the release of certain myokines.

BFR training can be a valuable tool for enhancing muscle growth and strength, but it requires proper knowledge, technique, and caution. Always consult with a qualified professional before attempting BFR training, as there are certain risks associated with its use.

# POTENTIAL BENEFITS OF BFRT/BFR

- ## Muscle Hypertrophy

  BFR training has been shown to stimulate muscle growth and increase muscle size, particularly in fast-twitch muscle fibers, leading to greater strength and power gains.

- ## Strength and Performance Gains

  BFR training can enhance muscular strength and performance, even when using low-intensity exercises, allowing individuals to achieve similar strength gains to high-intensity resistance training but with lighter loads.

- ## Rehabilitation and Injury Recovery

  BFR has demonstrated promising results in rehabilitation settings, helping prevent muscle atrophy during immobilization or post-injury and facilitating faster recovery and return to function.

- ## Improved Endurance and Cardiovascular Health

  BFR training has shown potential benefits in improving endurance performance and cardiovascular health by increasing oxidative capacity and promoting vascular adaptations.

- ## Time-Efficient Training

  Due to its ability to elicit significant gains with lighter loads, BFR training can be time-efficient, making it suitable for individuals with time constraints or during periods of reduced training availability.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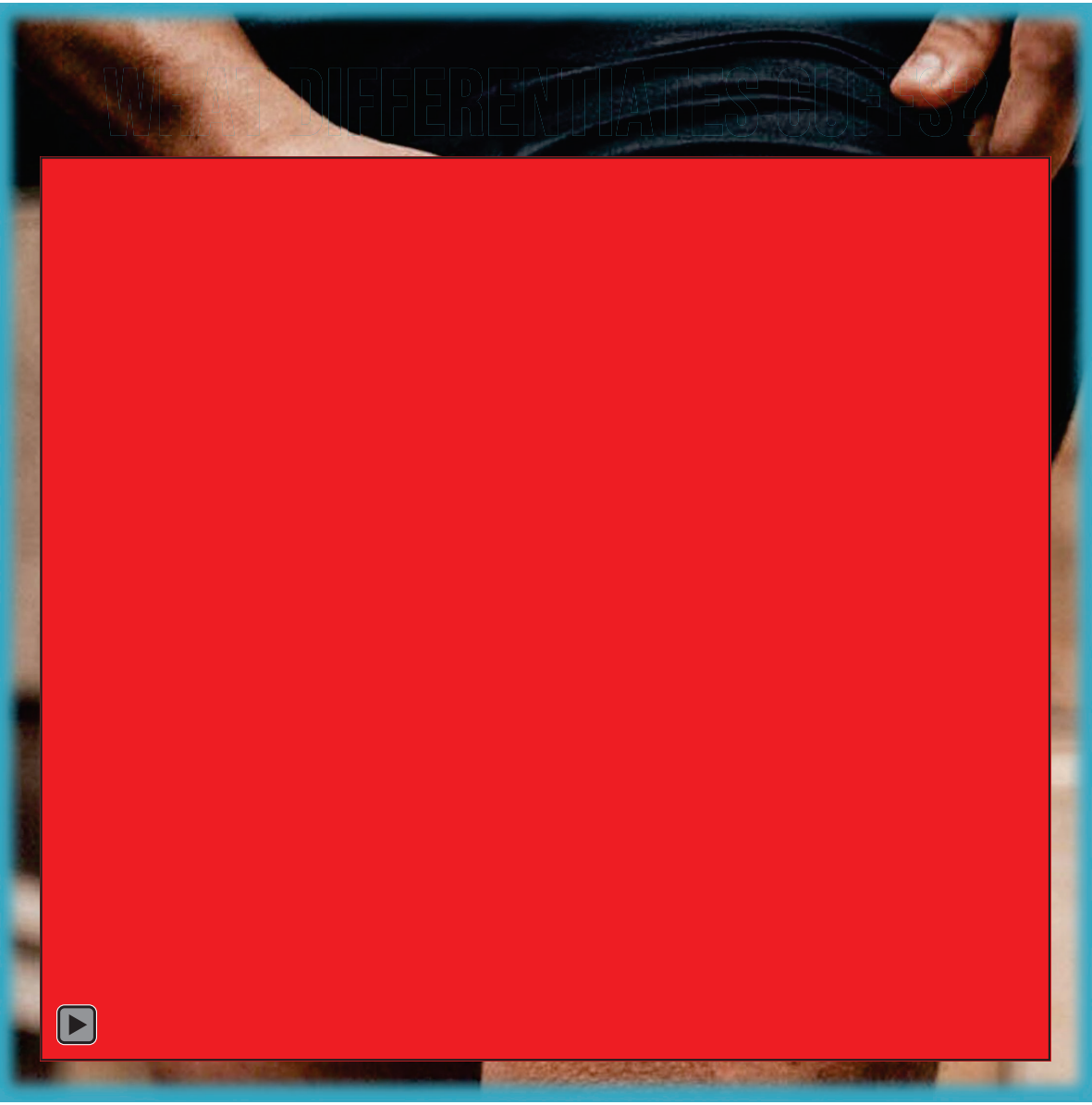

WHAT DIFFERENTIATES US

# SAFETY CONSIDERATIONS IN IMPLEMENTING BLOOD FLOW RESTRICTION THERAPY

Blood Clotting Disorders

Hypertension

Cardiovascular Disease

Nerve or Vascular Impairment

When implementing BFRT in concussion and dysautonomia rehabilitation, it is essential to carefully evaluate each patient's medical history and current health status to ensure their safety and minimize the risk of complications.

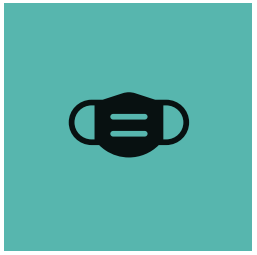
# SCREENING AND SAFETY

### Medical History Review

Identify any conditions that may impact the response to BFR exercise, such as issues related to exercise pressor reflex sympathetic tone.

### Special Conditions Consideration

Evaluate co-existing conditions, like pregnancy, that may influence the suitability of BFR training. Approach pregnancy with caution for individuals without prior BFR experience.



### Seek Expert Advice

If uncertainty remains, consult with experts or medical professionals experienced in BFR training to ensure safety and proper implementation.

Thorough screening and safety considerations are crucial when implementing Blood Flow Restriction (BFR) in concussion and dysautonomia rehabilitation to ensure the well-being of the individuals undergoing the treatment.

# UNDERSTANDING CONCUSSIONS

Traumatic brain injury (TBI) can disrupt normal brain activity, leading to temporary impairment and a range of physical, cognitive, and emotional symptoms. This pathophysiology is often associated with dysautonomia.

# PATHOPHYSIOLOGY OF MTBI

### Axonal Injury Causing Hub Disruption

Traumatic brain injury can lead to diffuse axonal injury, causing disruption in critical neural communication hubs that integrate and process information across the brain.

### Energy Imbalance Causing Hypometabolic State

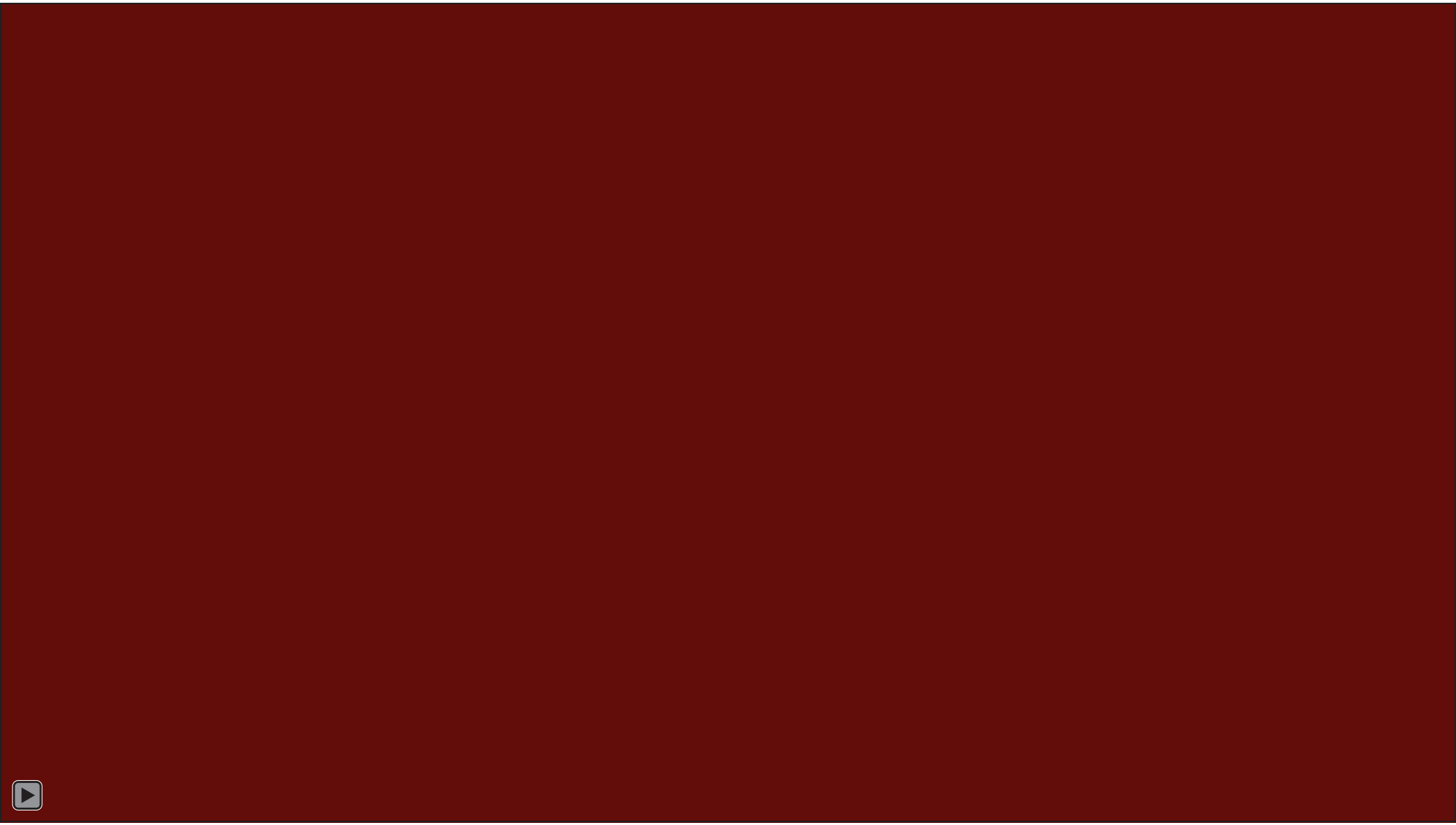
The increased energy demands of the injured brain are not met efficiently, leading to a hypometabolic state where the brain's overall metabolism is suppressed.

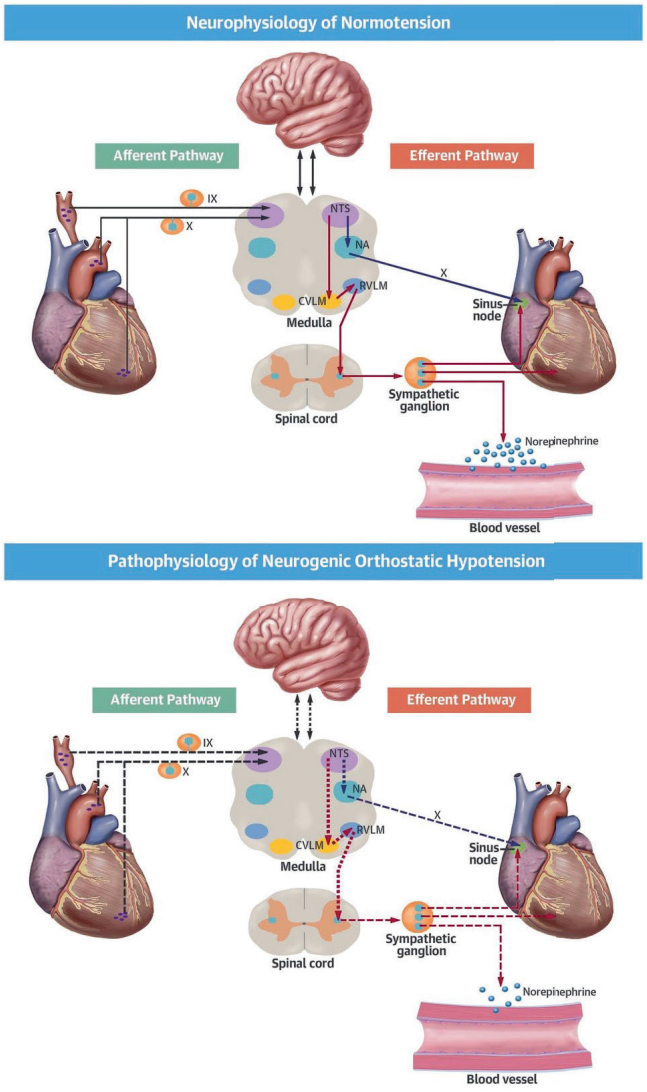
### Altered Blood Flow and Mitochondrial Function

Impaired cerebral blood flow and mitochondrial dysfunction contribute to the reduced energy production in brain cells, further exacerbating the metabolic crisis.

### BBB Permeability Causing Cerebral Edema

Increased permeability of the blood-brain barrier allows for fluid accumulation and swelling in the brain, further compromising neurological function.






Freeman, R. et al. J Am Coll Cardiol. 2018;72(11):1294–309.

# Exercise Pressor Reflex

## How It Works

Activated during muscle contraction by stimulation of receptors that respond to either mechanical distortion or the metabolic by-products of exercising skeletal muscle. Stimulation of these receptors generates somatosensory signals which are transmitted to the central nervous system via group III (predominately mechanically sensitive) and unmyelinated group IV (predominately metabolically sensitive) afferent fibre

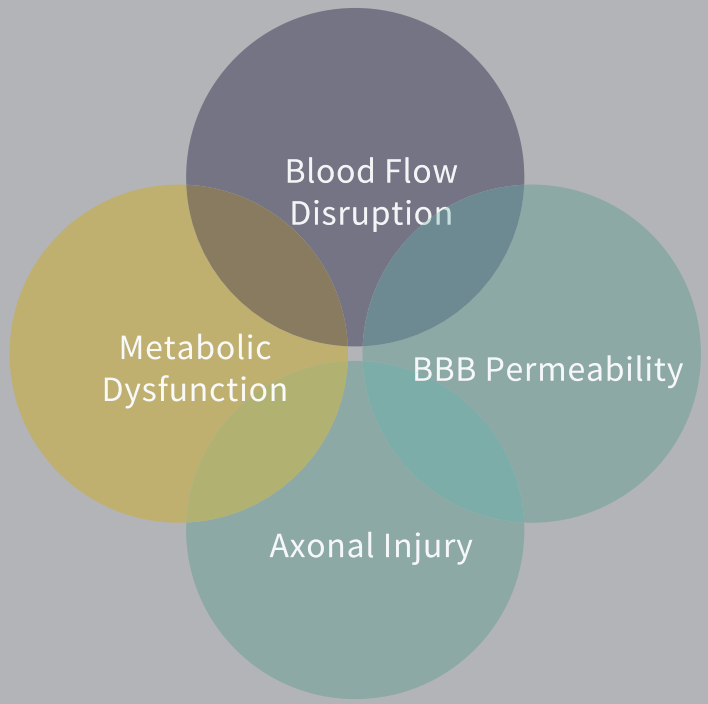
(Mitchell & Smith, 2008).

# Exercise Pressor Reflex

## How It Works

Metabo- and mechanoreflex lead to vagal withdrawal and sympatho excitation. Releases the brakes and pumps the gas.
Increases BP, HR and TPR.
(Prodel et al., 2016).
If they are cleared for resistance training, they should be clear for safe application of BFRT
(Loenneket al.2011)

# RELATIONSHIP BETWEEN MTBI PATHOPHYSIOLOGY AND DYSAUTONOMIA



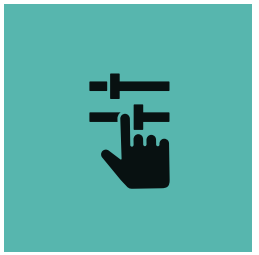
# AUTONOMIC DYSFUNCTION IN CHRONIC TBI

### High Prevalence

100% of a sample of 22 concussed patients showed abnormal autonomic testing, excessive heart rate changes, excessive blood pressure oscillations, headaches, postural lightheadedness, and syncope

### Autonomic Dysfunction

Dysfunction was reported from 48 hours to several years post-injury, often manifesting during physical challenges, isometric hand grip, and simulated orthostatic challenges



### Reduced Parasympathetic Involvement

Most studies demonstrated reduced parasympathetic involvement, and showed suboptimal response to autonomic challenge

Autonomic dysfunction is a common and persistent issue in chronic traumatic brain injury, with reduced parasympathetic involvement being a key characteristic.

# CLINICAL IMPLICATIONS

### Personalized Rehabilitation Plans

Develop individualized rehabilitation programs accounting for unique patient autonomic dysfunction profiles

### Multimodal Interventions

Incorporate blood flow restriction training, aerobic exercise, and neuromuscular retraining to address dysautonomia

### Continuous Monitoring

Utilize wearable technologies to track autonomic metrics and guide real-time adjustments to rehabilitation

Implementing a comprehensive, personalized approach that addresses the underlying autonomic dysfunction is crucial for optimizing recovery and quality of life in mTBI patients.

# ASSESSMENT AND MEASUREMENT TECHNIQUES

### Autonomic Reflex Screen (ARS)

Includes heart rate response to deep breathing, Valsalva maneuver, quantitative sudomotor axon reflex testing, and head-up tilt (HUT).

### Measurement Techniques

Common methods include HRV, cerebral perfusion manipulation, sympathetic response to stress, oculocardiac response, arterial pulse wave analysis, pupillary response to light, and isometric grip strength.

These autonomic assessment and measurement techniques are crucial for evaluating and monitoring concussion and dysautonomia rehabilitation progress.

# CLINICAL FINDINGS

- Orthostatic Blood Pressure and Pulse

  Assess changes in blood pressure and heart rate from lying to standing position to evaluate parasympathetic failure, sympathetic failure, and hypovolemia.

- Heart Rate Variability (HRV)

  Measure autonomic nervous system function, with increased low-frequency HRV amplitude post-concussion indicating elevated sympathetic outflow. Normal HRV score is around 59, deviations suggest autonomic dysfunction.

- Pupillary Light Reflex (PLR)

  Concussion affects pupillary light reflex, with delayed latency, smaller maximum diameter, larger minimum diameter, decreased pupil excursion, and slower recovery time, indicating potential biomarker for concussion.

- Valsalva Maneuver

  This autonomic reflex involves baroreceptor and cardiac control, with reduced autonomic modulation at rest, during, and following the maneuver in mild traumatic brain injury/concussion, including 30% heart rate increase during expiration and blood pressure normalization within 45 seconds.

# IMPLEMENTING BLOOD FLOW RESTRICTION IN CONCUSSION AND DYSAUTONOMIA REHABILITATION

## Classical Orthostatic Hypotension (OH)

A sustained reduction of at least 20 mmHg in systolic blood pressure (SBP) or 10 mmHg in diastolic blood pressure (DBP) within 3 minutes of standing or head-up tilt-table testing.

## Delayed Orthostatic Hypotension (DOH)

A sustained reduction in blood pressure that occurs after 3 minutes of standing or upright tilt.

## Initial Orthostatic Hypotension (IOH)

A transient reduction in blood pressure (≥40 mmHg SBP and/or ≥20 mmHg DBP) within 15 seconds of standing.

# TESTING FOR AUTONOMIC DYSFUNCTION

### Blood Pressure and Heart Rate Measurements

Measure after 5 minutes of supine rest. Repeat at 1, 3, and 5 minutes after standing. Use head-up tilt-table testing for controlled measurements.

### Symptom Documentation

Record symptoms: dizziness, lightheadedness, visual disturbances, fatigue, syncope. Note exacerbating factors: warm environments, prolonged standing, sudden postural changes.

### Autonomic Dysfunction Assessment

Evaluate the body's ability to regulate blood flow and heart rate in response to postural changes. This can help diagnose conditions like postural orthostatic tachycardia syndrome (POTS).

Comprehensive testing for autonomic dysfunction is crucial in the rehabilitation of concussion and dysautonomia patients to develop targeted treatment plans.

# BFR IN DYSAUTONOMIA MANAGEMENT

## Autonomic Dysregulation in Concussions

Concussions can lead to disruption in the autonomic nervous system, resulting in cardiovascular, gastrointestinal, and other physiological dysregulation.

## Applying BFR for Symptom Management

BFR therapy can be integrated into concussion rehabilitation to help address autonomic dysfunction, improve cardiovascular function, and manage post-concussion symptoms.

## Protocols for BFR in Dysautonomia

Specific BFR protocols, such as limb restriction and controlled exercise, can be tailored to improve heart rate variability, blood pressure regulation, and other autonomic markers in concussion patients.

## Monitoring and Adjusting Treatments

Continuous monitoring of vital signs and patient responses is crucial when applying BFR in this population. Rehabilitation protocols should be adjusted based on individual progress and symptom changes.

# INTEGRATING BFR THERAPY TO MANAGE POST-CONCUSSION SYMPTOMS

### Improve Muscular Endurance

BFR therapy can help enhance muscular endurance, aiding in recovery and preventing muscle atrophy after a concussion.

### Manage Post-Concussion Fatigue

BFR can help mitigate post-concussion fatigue by improving cardiovascular fitness and oxygen utilization.

### Enhance Neuromuscular Function

By promoting muscle activation and recruitment, BFR can help restore proper neuromuscular control and coordination post-concussion.

### Gradual Progression of Rehabilitation

Adjusting BFR protocols based on patient progress allows for a gradual, tailored rehabilitation approach.

Integrating BFR therapy into post-concussion rehabilitation can effectively manage symptoms, enhance recovery, and provide a structured, progressive approach to rehabilitation.

# Chief Complaint History:

- Location: Back of head
- Onset: 01/2023
- MOI: Head contacted a metal rod
- Characteristic: Dull/Achy
- Radiation: None
- Associated Symptoms: Neck pain, nausea, dizziness, lightheaded, balance problems, brain fog, fatigue, anxiety
- Time/Duration: Constant
- Severity: 5/10, 8/10 at worst

## Chief Complaint History:

- Exacerbating Factors: increased with physical activity and mental activity
- ADL's Affected: Ability to work/study for longer than 30 minutes
- Relieving Factors: Rest/sleep and/or OTC NSAIDS
- Red Flags: None
- Other Pertinent Information: No prior history of concussion. Went to Urgent Care 2 days after and had a CT and neck X-ray. Both were within normal limits.

7 archetype of concussion (COACH CV)[1]

- Cognitive Problems
- Oculomotor dysfunction
- Affective disturbances
- Cervical spine disorders
- Headaches
- Cardiovascular
- Vestibular

# Differential Diagnoses

1. Post concussion Syndrome
   - Includes:
     - Headache
     - Oculomotor Dysfunction
2. Neck Pain/Cervical Dysfunction
3. **Postural Orthostatic Tachycardia Syndrome**
4. Fatigue
   - Potential Labwork needed

# Exercise Guidelines in Concussion Management

Content:

- Heart Rate Threshold (HRt):
  - Maximum heart rate achieved during the Buffalo Concussion Treadmill Test (BCTT) at symptom exacerbation.
  - Safe exercise level: Below 90% of HRt.

- Symptom-Limited Exercise Intolerance:
  - If patient can exercise to voluntary exhaustion without symptom exacerbation, but has symptoms at rest or physical examination impairments:
    - Aerobic exercise is allowed up to the maximum achieved HR or at 85% of age-appropriate maximum.

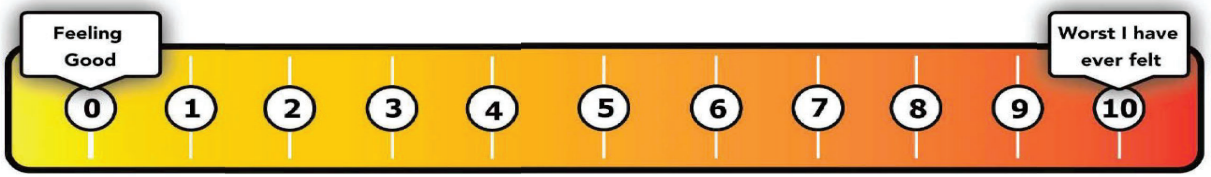
- Symptoms at Rest without Physiologic Threshold:
  - Patients with symptoms at rest but without a physiologic threshold (can exercise to max without symptom increase):

Borg Rating of Perceived Exertion

# VISUAL ANALOGUE SCALE (VAS)

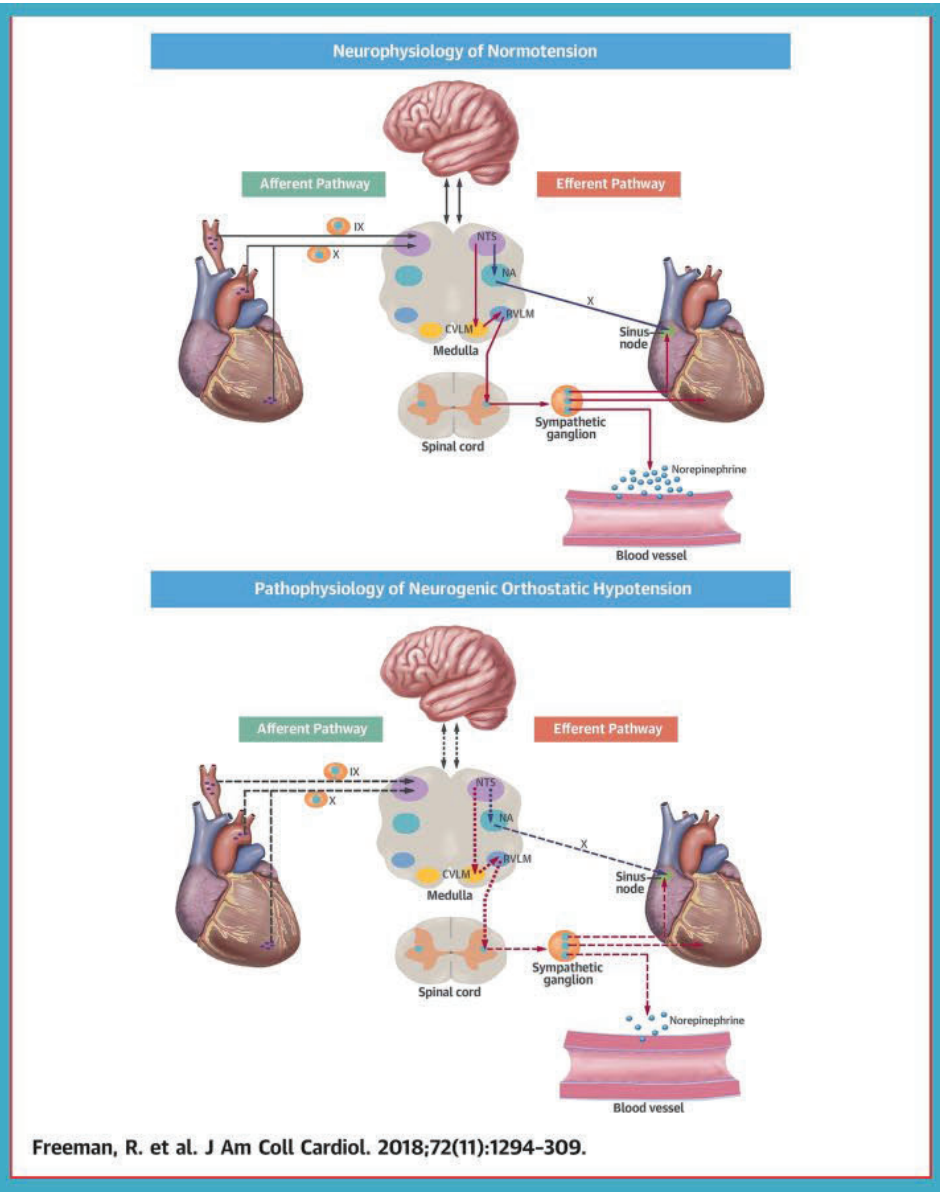
## Rate Your Overall Condition

**Choose a number from 0 to 10 and describe your condition.**




| 0 | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| Feel Terrific No Symptoms | Feel some symptoms but quite tolerable | Symptoms a little worse | Symptoms worse | Symptoms much worse | Feel Terrible Worst I ever felt |

**BE SURE TO TELL YOUR DOCTOR THE CONDITION YOU ARE IN**

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# Physical Examination:

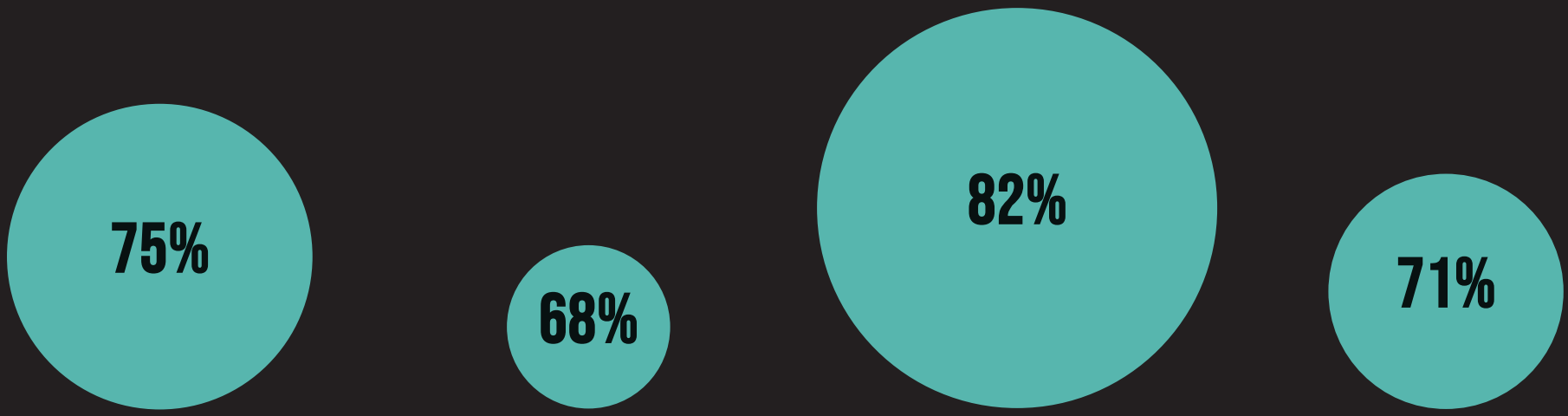
- Positional Blood Pressure Testing Results:
  - BP Supine: 91/73; HR supine: 74 BPM
  - BP Sitting: 136/87; HR sitting: 80 BPM
  - BP Standing: 136/73; HR Standing: 69 BPM
    - A change in Systolic BP of greater than 20 mmHg from one position to another could be indicative of autonomic nervous system dysfunction and postural hyper/hypotension[2]
- Pertinent Neuro Exam :
  - Saccadic Pursuits
  - Convergence Insufficiency
  - Romberg's Sign
  - Dysmetria with right hand during finger-to-nose movement
- Pertinent Orthopedic Tests:
  - All within normal limits
- Pertinent Soft Tissue Palpation/Motion Palpation:
  - Spasms of Cervical Paracervical and Suboccipital muscles
  - Reduced ROM with Left Rotation and Left Lateral Flexion
  - Segmental Dysfunction of Cervical Spine and Upper Thoracic Spine

# Exercise Guidelines in Concussion Management

RIPC aug protocol resulted in an immediate and sustained reduction in Heart Rate Variability (HRV), extending into the following morning. This suggests a significant impact on cardiac autonomic modulation. In contrast, while Remote RIPC led to an immediate reduction in Heart Rate (HR), there were no significant changes in HRV indices. These findings highlight the varying effects of different protocols on autonomic function, with RIPCaug causing a prolonged disturbance, potentially influencing the observed ergogenic benefits associated with these techniques. (Morley et al., 2021)

- Rpm under occlusion a target Hr same
- Lop 60% progressing to 80%
- 15m bilateral
- Progress increase cycle of occlusion
- 3 on 3 off
- 3 rounds =15m

Percentage improvement in function, pain, and quality of life



# KEY SUMMARY POINTS

1. Prevalence and Impact: Dysautonomia is common after concussions, with nearly all studies indicating autonomic anomalies, such as altered heart rate and blood pressure regulation.

2. Symptoms and Assessments: Symptoms of dysautonomia include changes in heart rate and blood pressure, assessed using tools like the COMPASS 31 survey, which identifies significant dysfunction.

3. Autonomic Responses: Most concussion patients show reduced parasympathetic involvement and suboptimal autonomic responses, emphasizing the need for thorough autonomic function assessments in concussion management.

# REFLECTION POINTS

1. Assessment and Diagnosis:

How can healthcare providers effectively differentiate between dysautonomia symptoms caused by concussions and those arising from other medical conditions, to ensure accurate diagnosis and treatment?

2. Treatment and Management:

In what ways can blood flow restriction training be safely integrated into the rehabilitation programs for patients with dysautonomia following a concussion, and what specific precautions should be taken to mitigate risks?

3. Monitoring and Adaptation:

What strategies can be implemented to continuously monitor the autonomic function of patients undergoing blood flow restriction training, and how can these strategies be adapted to address any emerging complications related to dysautonomia?

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