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CLINICALEXPOSITION

Carbon Dioxide regulation, respiratory mechanics, and Autonomic function: A potential role for Chiropractic care

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Narrative: Carbon dioxide plays a central role in cerebral circulation, acid–base balance, respiratory drive, and autonomic regulation. This clinical exposition explores how disturbed carbon dioxide homeostasis, particularly hypocapnia associated with excessive ventilation, may contribute to neurological and autonomic symptoms. It examines the relationship between restricted thoracic and rib cage mobility, dysfunctional breathing patterns, and ventilatory inefficiency.

Chiropractic adjusting, combined with targeted diaphragmatic and nasal breathing exercises, is proposed as a potential adjunct to multidisciplinary management. The paper emphasises matching ventilation to metabolic demand and considering respiratory mechanics alongside neurological, cardiovascular, and metabolic factors when developing comprehensive care strategies for affected patients.

Indexing terms: Chiropractic; Carbon Dioxide; hypocapnia; hypercapnia; multidisciplinary care.

Introduction

A fundamental component of life is breathing. While most consider oxygen during breathing, carbon dioxide (CO2) may be one of the most misunderstood molecules in human physiology. CO2 is not only a waste product the body eliminates, but is a critical regulator of blood flow, nervous system function, acid-base balance, breathing drive, and cerebral circulation.

In many neurological and autonomic disorders, including dysautonomia, postural orthostatic tachycardia syndrome (POTS), vestibular disorders, chronic fatigue, post-concussion syndrome, and chronic anxiety states, abnormal CO_2 regulation may play a significant role in symptom generation. Understanding how CO_2 influences the brain and body can provide valuable insight into why patients experience dizziness, air hunger, brain fog, fatigue, headaches, and exercise intolerance.

> *'... For many patients, learning to breathe more efficiently rather than more forcefully or rapidly may be one of the most important steps toward reducing symptoms and improving neurological resilience ...'*

Regarding breathing mechanics, chiropractors are uniquely positioned to help patients improve respiratory function through the mobilisation of the rib cage and thoracic spine. By restoring mobility to these structures and combining it with targeted breathing exercises that emphasise diaphragmatic activation and efficient breathing patterns, chiropractors may play an important role in supporting patients with autonomic nervous system disorders. Improved thoracic and rib cage mobility can enhance respiratory mechanics, optimise ventilatory efficiency, and potentially influence autonomic regulation through better integration of respiratory and nervous system function.

Understanding Carbon Dioxide

Carbon dioxide is produced continuously by every cell in the body during metabolism. As cells utilise oxygen to generate energy within the mitochondria, CO_2 is created as a byproduct. This CO_2 enters the bloodstream and is transported to the lungs, where it is exhaled. Most of the body's CO_2 is not transported as a gas. Instead, it is converted into bicarbonate through a reversible chemical reaction involving water and carbonic acid. This bicarbonate system serves as one of the body's primary buffering mechanisms for maintaining blood pH. As a result, CO_2 is intimately connected to acid-base regulation, vascular control, and nervous system function.

Normal arterial carbon dioxide pressure ($PaCO_2$) generally ranges from approximately 35 to 45 mmHg. Values below 35 mmHg are referred to as hypocapnia, meaning low carbon dioxide levels. Values above 45 mmHg are referred to as hypercapnia, meaning elevated carbon dioxide levels. Even relatively small changes in CO_2 can significantly alter blood vessel diameter, cerebral blood flow, autonomic function, and symptoms. The brain is particularly sensitive to changes in CO_2 because it uses carbon dioxide levels as a major signal to regulate blood flow and breathing.

Carbon Dioxide and the brain

Carbon dioxide acts as a potent vasodilator in the brain. When CO_2 levels rise, cerebral blood vessels expand and increase blood flow. When CO_2 levels fall, cerebral blood vessels constrict and blood flow decreases. A drop in CO_2 of only a few millimetres of mercury can reduce cerebral blood flow by as much as 20-40%. This highlights one of the intimate relationships between breathing and cerebral blood flow.

Low CO_2 most commonly occurs from excessive ventilation, also known as hyperventilation. Importantly, hyperventilation does not necessarily mean breathing rapidly. Many individuals hyperventilate by breathing too deeply, taking frequent sighs, overusing accessory respiratory muscles, or unconsciously breathing through the mouth. Because excessive breathing removes CO_2 faster than it is produced, blood levels begin to fall. Common causes of low CO2 include, but are not limited to, anxiety/panic disorders, chronic stress, dysautonomia, chronic pain, concussion/TBI, vestibular disorders, over-breathing during exercise, sleep-disordered breathing, and chronic mouth breathing.

Elevated CO_2 usually results from inadequate ventilation. In these situations, the lungs are unable to adequately eliminate CO_2, causing levels to rise. While hypercapnia can cause symptoms, many neurological and autonomic patients more commonly struggle with hypocapnia. Common causes include, but are not limited to, chronic obstructive pulmonary disease (COPD), asthma, neuromuscular disorders, obesity hypoventilation syndrome, sleep apnea, sedative medications, respiratory muscle weakness, and advanced pulmonary disease.

Exploring the Chiropractic role in Carbon Dioxide homeostasis

Many patients assume they need more oxygen when they feel these symptoms. They may need more carbon dioxide. Individuals with low CO_2 levels may experience symptoms of brain fog, difficulty concentrating, dizziness, lightheadedness, visual disturbances, fatigue, head pressure/ headaches, feelings of discomfort, air hunger, palpitations, tingling of the face and/or hands, exercise intolerance, sleep disturbances, and cognitive slowing. Improving rib cage mechanics and breathing patterns may help address hypocapnia, a condition characterised by abnormally low levels of carbon dioxide (CO_2) in the blood.

When the rib cage and thoracic spine are restricted, individuals frequently compensate by relying on shallow, rapid upper-chest breathing rather than efficient diaphragmatic breathing. This pattern can increase respiratory rate and ventilation beyond the body's metabolic needs, causing excessive CO_2 elimination. By restoring mobility to the rib cage and thoracic spine, patients are often able to take deeper, more efficient breaths with less effort. When combined with breathing exercises that emphasise diaphragmatic activation, slower respiratory rates, nasal breathing, and improved breath control, ventilation can become better matched to metabolic demand. This may reduce excessive CO_2 loss and help normalise carbon dioxide levels.

Understanding the physiology of carbon dioxide shifts the focus from simply increasing oxygen intake to restoring the proper balance between oxygen, carbon dioxide, blood flow, and autonomic regulation. For many patients, learning to breathe more efficiently rather than more forcefully or rapidly may be one of the most important steps toward reducing symptoms and improving neurological resilience.

However, when the thoracic cage and rib cage are restricted in mobility, normal breathing mechanics may be compromised, limiting both respiratory efficiency and the effectiveness of breathing exercises. This creates a unique opportunity for Chiropractors to co-manage patients by improving thoracic and rib cage mobility, thereby supporting more efficient breathing patterns and potentially contributing to improvements in autonomic function, cardiovascular regulation, and pulmonary symptoms. This relationship further emphasises the importance of a multidisciplinary, team-based approach to healthcare.

Conclusion

Many patients present with complex signs, symptoms, and comorbidities that span multiple physiological systems. By addressing mechanical, neurological, respiratory, cardiovascular, and

metabolic factors simultaneously, healthcare providers may be better positioned to identify contributing factors and develop more comprehensive treatment strategies.

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Also by Dr Traster

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