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Breathing evaluation and retraining as an adjunct to manual therapy

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ABSTRACT

Back and neck pain are extremely common reasons for patients seeking manual therapy treatment. Epidemiological evidence supports a link between breathing difficulties and back pain. Since trunk muscles perform both postural and breathing functions, it is theorized that disruption in one function can negatively impact the other. Altered breathing mechanics can change respiratory chemistry and therefore pH causing smooth muscle constriction, altered electrolyte balance and decreased tissue oxygenation. These changes can profoundly impact any body system. Increased excitability in the muscular and nervous systems may be most relevant to a manual therapist. Respiratory function can be tested via capnography which measures CO_2 at the end of exhale known as End Tidal CO_2 ($ETCO_2$). $ETCO_2$ closely reflects arterial CO_2 in people with normal cardiopulmonary function.

A case series of twenty nine outpatients with neck or back pain who had plateaued with manual therapy and exercise were identified all of whom were found to have low $ETCO_2$. Breathing retraining improved $ETCO_2$, pain and function in all patients with 93% achieving at least a clinically important change in either pain or function.

Screening for breathing dysfunction using capnography may improve patient outcomes in those patients where manual therapy, exercise and education do not provide full resolution of symptoms.

1. Introduction

Back and neck pain are extremely common in patients seeking manual therapy treatment. Epidemiological evidence supports a link between breathing difficulties and back pain (Smith et al., 2006). Since trunk muscles perform both postural and breathing functions, it is theorized that disruption in one function can negatively impact the other (Hodges et al., 2007). Altered breathing mechanics can change respiratory chemistry and therefore pH causing smooth muscle constriction, altered electrolyte balance and decreased tissue oxygenation (Levitsky, 2003). These changes can profoundly impact *any* body system leading to a wide range of possible symptoms (Thomson et al., 1997). Increased excitability in the muscular and nervous systems may be most relevant to a manual therapist. Respiratory function can be tested via capnography which measures CO_2 at the end of exhale known as End Tidal CO_2 or $ETCO_2$ (normal = 35–45 mm Hg). $ETCO_2$ closely reflects arterial CO_2 in people with normal cardiopulmonary function. Capnography is used in critical care settings and is considered an accurate, time sensitive arterial CO_2 measure (Miner et al., 2002). To investigate breathing as a possible contributor to musculoskeletal pain a pilot study was undertaken.

2. Purpose and relevance

The purpose of this study was to determine whether poor respiratory chemistry was present in a series of patients with neck or low back pain and secondly whether biofeedback training could improve chemistry, pain and function.

3. Methods

A case series of twenty nine outpatients with neck ($n = 12$) or back pain ($n = 8$) or both ($n = 9$), symptom duration, (1–156, mean = 38, median = 24 months) who had plateaued with manual therapy, education and exercise were identified to determine whether poor respiratory chemistry was present using a capnograph (Better Physiology, Santa Fe NM). Pain was measured with the Numeric Pain Rating Scale (NPRS) (Stratford and Spadoni, 2001) and function by the Patient Specific Functional Scale (PSFS) (Westaway et al., 1998). The patients underwent an individually

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customized breathing retraining intervention after which the NPRS, PSFS and $ETCO_2$ were retested. Paired *t* tests were performed on the before and after data for each test with 2-tailed *p* values.

4. Intervention

To tailor the intervention to each individual a series of challenges were conducted. Three of the challenges were postural including sitting, standing and supine. Sitting and standing require postural control from the trunk muscles whereas supine has limited postural demands. If there was a clear improvement in supine, a muscle strategy problem was suspected and a manual therapy/motor control approach was implemented. Since increases in breath rate and volume can lead to overbreathing, both were addressed by performing repeated deep breaths and a 20 breaths per minute rate challenge.

Once the poor breathing profiles (low CO_2, high respiratory rate, erratic non rhythmic patterns, upper chest breathing) were identified, awareness training and biofeedback with the capnograph and manual therapy to restore mobility if required were used to retrain breathing to attain better profiles. Breathing retraining was complete once the patient was able to consistently keep their $ETCO_2$ within the normal range and felt confident that they understood and could control their breathing. In these patients, the number of sessions varied from 2 to 15 (mean and median 5).

5. Results

All 29 patients had below normal $ETCO_2$ (<35 mm Hg) on initial testing. Improvements in $ETCO_2$ values varied from 0 to 11, mean 6, median 7, SD 3, 95% Confidence Interval: 5.0, 7.2 all in mm Hg; $p < 0.001$.

NPRS improved in all patients and reached the minimum clinically important difference (MCID) in 66%. PSFS improved in all patients and reached the MCID in 79%. There was an MCID in at least one of the two scales in 93% of the subjects (Table 1).

Table 1
Pre treatment, post treatment and difference values.

Variable	Pre	Difference*	Post
NPRS	6.1 (1.7)	3.2 (1.8)	2.9 (1.7)
PSFS	13.5 (4.0)	7.1 (5.2)	20.6 (5.3)
Sitting CO_2	31.0 (3.2)	6.1 (2.9)	37.1 (2.3)

Data expressed as mean (standard deviation).
*$p < 0.001$.

6. Clinical implications

Capnography has concurrent validity when compared to arterial CO_2 measures and can provide access to this very relevant physiological information. Since blood flow to the brain for example is reduced by 20% when arterial CO_2 is reduced even slightly below normal to 34 mm Hg (Thomson et al., 1997), raising CO_2 to normal levels may represent a clinically important effect.

While this study did not use a control group, it demonstrated hypocapnia in all patients at baseline. Breathing dramatically improved in a mean of 5 treatment sessions regardless of age, gender, symptom location or duration. These results were both clinically important and statistically significant.

Screening for breathing dysfunction using capnography can be easily integrated into a manual therapy approach. Incorporating breathing management may improve patient outcomes in those patients where current best practice of manual therapy, exercise and education do not provide full resolution of symptoms. These results should be confirmed with a proper randomized controlled trial to ensure usefulness in a musculoskeletal patient population.

Conflict of interest

LM is a distributor for and a minor shareholder in Better Physiology, the capnograph manufacturer.

CHG and KC have no conflicts of interest.

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