INTRODUCTION

Sir John Lubbock, the 19th century English banker and biologist, must have had modern day health care providers in mind when he said, “What we see depends mainly on what we look for.” This simple, yet profound, observation is particularly true when viewing a therapeutic intervention through the eyes of another profession, one that’s not providing the care. What we see when we evaluate a patient is largely guided by our training and experience. Where a physical or occupational therapist might see “optimal posture” or “symmetrical alignment” in a patient fitted for a new wheelchair seating system, a respiratory therapist may see an overly restricted abdomen and chest wall. With increasing technical sophistication, health care demands practitioners become specialized. The real challenge of specialization is to have enough general knowledge and awareness so what we look for, and what we see, guides our interventions and ensures the best possible patient outcomes. Most often our recommendations on postural angles are based on pressure and functional activity. However, we need to have enough general awareness of the respiratory status to ensure our efforts do not compromise our patients breathing.

ASSESSMENT OF BREATHING

Determining the effect of any intervention on a system requires a pre-and post-intervention assessment and an evaluation of any change that may have occurred. Assessment of breathing is both a subjective and objective process. Subjective assessment should include simple observation of the breathing pattern – slow and regular or rapid and shallow, relative use of accessory muscles, ability to speak in full sentences, and patient sensation of shortness of breath (dyspnea). These subjective observations should be made without drawing the patient’s attention to the fact you are observing their breathing. Talk to the patient, ask questions and mentally note the volume and duration of their voice as they respond. Determining the degree of dyspnea requires a conscious assessment on the part of the patient. Calling a person’s attention to their breathing often alters their breathing pattern, which is the main reason why we want to leave the assessment of dyspnea to last. Ask the patient to describe his/her sensation of shortness of breath using a 1-10 scale, with one being no difficulty at all and 10 being a sensation of suffocation. Make mental notes or write down your observations and the patient’s response to your dyspnea inquiries.

NORMAL BREATHING

Normal breathing is controlled not by the need for oxygen, but rather by the need to regulate the level of carbon dioxide resulting from normal metabolism. To maintain a stable level of carbon dioxide, we need to move a specific amount of air into and out of our lungs each minute. We do that either by breathing slowly and taking large breaths, or by breathing faster while taking smaller breaths. Faster breathing is a much less efficient method. Normal people – those without muscular or skeletal abnormalities – breathe 12 to 18 breaths per minute. For them, breathing occurs along three planes and can be seen as a “bottom-up” process. As inspiration begins, the diaphragm contracts downward, elongating the lungs as they fill with air and push the abdomen forward, a process referred to as abdominal breathing. Next, the intercostals muscles draw the lower ribs upward expanding the chest from side to side. Finally, towards the end of inspiration the upper ribs are drawn forward and up. By far, the most important segment of a breath is the abdominal breathing component which relies on contraction of the diaphragm, a muscle which accounts for 80 percent to 85 percent of the air moved with each breath.

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efficiency is more energy and oxygen are consumed to move the same amount of air, and more carbon dioxide is produced – meaning even more air will need to be moved just to maintain a normal resting state.

Objective measures, which can be easily and rapidly made include respiratory rate, heart rate and oxygen saturation. The normal resting respiratory rate is typically in the range of 12 to 18 breaths per minute. However, in patients with neuromuscular disease or deformation of the chest wall, higher resting respiratory rates are common. An increase in resting respiratory rate is a very good indicator of breathing restriction. If an intervention restricts the volume of air the patient can take in with each breath (tidal volume), the patient will have to take more breaths per minute to keep up with their metabolic demand. As respiratory rate rises, it is quite common to observe corresponding increases in the use of accessory muscles and in the sensation of dyspnea, along with a reduced ability to speak loudly and in full sentences.

We need to recognize these signs of breathing restriction and aggressively act on them when they are present. These actions should include removing any devices, straps or belts that may limit the movement of the chest or abdomen as well as changes in posture that may have recently occurred. Left uncorrected, restricted breathing can lead to progressive collapse of lung units (atelectasis), deterioration of gas exchange and progressive cardio-respiratory complications.

Finger-tip pulse oximetry offers a simple, rapid and relatively reliable assessment of cardio-respiratory performance. Pulse oximeters provide real-time data on arterial oxygen saturation (normal range 95 percent to 98 percent) and heart rate. Just as with respiratory rate, chest wall deformation may negatively impact normal oxygen saturation (SPO2) by causing chronic atelectasis. Baseline pre-intervention assessment should be the standard of care. A small immediate increase in heart rate may result from changes in posture and positioning. However, large changes do not typically occur by themselves, but rather are accompanied by reductions in oxygen saturation. Even small decreases in oxygen saturation should trigger full reassessment of the patient. Imposing new restrictions that limit lung expansion can cause atelectasis, which will progress over time. So, small changes in oxygen saturation seen within a half-hour of an intervention may signal a progressive process which could result in significant complications, including respiratory failure and arrest.

BEYOND POSITIONING, PRESSURE AND FUNCTION

When assessing patients for a seating system, close attention is generally paid to posture, function and pressure distribution. However, little consideration is given to the impact those postural changes and structural support systems could have on respiratory function. Further, there is little research to guide us on respiratory function directly related to wheelchair seating. There is a recent newfound interest in understanding this relationship and how it impacts seating and positioning recommendations. This awareness will help the seating and mobility specialist to maximize postural alignment without compromising breathing mechanics. The mechanics of breathing are directly impacted by primarily progressive disease states and the impact skeletal alignment of the spinal column and rib cage have on the diaphragm mechanics, lung expansion and use of accessory breathing muscles. They are directly impacted by lack of postural control and, at times, attempts to “over control” by custom molded shapes and/or external postural supports, such as lateral thoracic pads which impact free rib cage expansion.

The APTA Guide to Physical Therapy Practice identified the primary systems involved in postural control and movement as musculoskeletal, neuromuscular, cardiovascular/pulmonary, integumentary and internal organs, specifically gastrointestinal. Internal organs that generate and/or use positive pressure are the pulmonary system, heart/circulation, gastrointestinal tract and the lymphatic system. Studies by Massery, confirm the need to create client solutions that “generate, regulate and maintain trunk pressures for optimal respiratory mechanics and postural alignment.”

The integrity of the skeletal system is imperative for posture and respiration. The ribs were designed for mobility at the expense of stability. As far as the relationship to wheelchair seating posture, subtle changes in seating can affect how the ribcage moves. In fact, posterior stability of the spine provides the stability for the anterior rib cage to expand, and positive pressures provide trunk and postural stability, thus allowing freedom of movement of not only the rib cage, but the individual’s functional movement. Hodges and Gandevia also found respiration and posture are linked. Hodges, 2007, suggested multiple relationships between the trunk, pelvic floor, diaphragm and shoulder muscles and their role in postural stability and tasks. The clinician has access to a number of tools to assess diaphragm function in patients with neuromuscular disorders. A detailed history and physical exam that focuses on inspection and palpation of the respiratory muscles and motion of the chest wall are an indication of respiratory muscle weakness. Increased lumbar lordosis increased lung volumes for patients seated in their wheelchairs. We know shifting the pelvis toward an anterior pelvic tilt...
opens the anterior chest wall and tends to facilitate more upper chest breathing, while a posterior tilt where the pelvis rolls backward facilitates more diaphragmatic breathing. Positioning of the upper extremities and head and neck will also affect respiration and breathing as well.

Little research exists specifically evaluating the effect of tilt, recline or tilt and recline on respiratory function. Most often, our recommendations on postural angles are based on pressure and functional activity, but not specifically on respiration. One such study by Fromageot does refer to forced expiratory flow rates which are reduced in patients with neuromuscular weakness. The fall in VC between the upright and supine positions has been used to assess diaphragm weakness and is a more sensitive indicator of respiratory muscle weakness than upright measures of VC and TLC. Further exploration in this area would be valuable to improve our recommendations for power seating angles for clients with progressive diseases to take into consideration pressure and respiratory management. Some investigation in the use of binders for postural support shows an effect on respiration. For instance, Frownfelter found that for individuals without pathology, both a thoracolumbar-sacral orthosis (TLSO) with and without abdominal cut-out showed decreases in forced vital capacity (FVC) and forced expiratory volumes, but those with an open TLSO had less decrease than those with the closed TLSO. The clinical relevance is patient complaint of dyspnea when a TLSO is needed to stabilize the spine for various pathologies. This can cause poor compliance issues, and an abdominal cut-out may provide a positive compromise. [6]

CONCLUSION

Contemporary medical literature and professional consensus have recognized the effect postural support and positioning has on respiratory function. The wheeled seating and mobility industry understands and is embracing this relationship. This is evidenced by new research endeavors focused on specific seating interventions in which respiratory measures are used to ensure newer seating systems accomplish postural support goals without compromising respiratory function. It is incumbent each of us develops an awareness of respiratory function in order to ensure our interventions offer each client the best possible outcome.

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REFERENCES