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FACING SURGERY WHEN BREATHING IS A PROBLEM

Scoliosis, Ventilation, & Surgery

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How does scoliosis affect breathing? Consider a typical, moderate curve of the spine of an individual. We usually look at the outside of the body to determine what is happening to the inside of the body, to the lungs, and the heart. The twisting of the ribs backwards causes the lung to be similarly twisted into that shape and partially compressed. Distortion of the lung happens not only on the side of the convexity, but on the other side as well, the side of concavity.

When considering breathing, we are particularly interested in the cervicothoracic curve (apex at C7-T1), the thoracic curve (apex between T2-T11), and the thoracolumbar curve (apex at T12-L1). These are the ones that can affect cardiopulmonary function. Curves are classified by the number of degrees of lateral curvature. Curves in group III (31-50°) and group IV (51-70°) and beyond are the ones that cause more problems insofar as anesthesia and surgery are concerned.

There are several specific neuromuscular diseases which can cause curvatures including muscular dystrophies, spinal muscular atrophy, cerebral palsy, spinal cord injury, spina bifida, and arthrogryposis. Post-polio scoliosis is probably most similar to the scoliosis associated with spinal muscular atrophy. For the person with neuromuscular scoliosis, it is important to know specific management techniques when the curve is the result of muscle weakness.

The surgical treatment of scoliosis has already been discussed (*Polio Network News*, Vol. 11, Nos. 2 & 3). Non-surgical treatments include observation, bracing, custom seating, and electrical stimulation which for the most part has fallen out of favor, because it has not proved to prevent further progression of the curve. Postural exercises, exercises to maintain spinal flexibility

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NEW BREATHING PROBLEMS IN AGING POLIO SURVIVORS

Respiratory Muscle Weakness

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In my pulmonary practice over the past 15 years, I have seen individuals who have a history of polio and who have respiratory problems but are unaware of them. Only one required ventilatory support during acute polio, and one other had known bulbar polio. The others had isolated or extensive limb involvement, even quadriplegia. Most had involvement in just a single limb. When studied, all of them had measurable respiratory muscle weakness. Anyone with a prior history of a neuromuscular disease, such as polio, needs to be evaluated in depth before and around stressful, physiologic events such as surgery.

Function of the respiratory muscles ... The diaphragm is the major muscle of breathing and its descent increases the length of the thorax and increases lung capacity. The external intercostal muscles pull the ribs up and out. The scalene muscles raise the rib cage and the sternum (or breastbone). Another muscle, the sternocleidomastoid, elevates and expands the rib cage. Negative pressure is created within the chest, and the increase in the dimension of the chest increases the volume of the lungs. Air then enters the lungs through the nose, and is inspired.

Expiration is a much less active process. The abdominal muscles pull the ribs down and push the diaphragm up. The internal intercostal muscles pull the ribs down and in and squeeze the air out. If either the inspiratory or expiratory muscle groups, or both, are not functioning properly, some type of respiratory assistance may be needed.

Representative case ... An individual with involvement (that she was aware of) only in her legs and who wears leg braces, works full time as a nurse. After routine gynecologic surgery, she developed pneumonia

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Because of my lack of muscle mass, I am unable to generate body heat if I am chilled. Warm to you may be chilling to me. When I am chilled, I feel great fatigue; my veins contract. Things that have chilled me in the past are: air conditioning not adjusted for me; cold tables; refrigerated saline to humidify oxygen; refrigerated IV fluids; iced drinks, including water, etc.

The left side of my throat is weaker than the right; thus I am susceptible to choking on liquids.

Like the extremely elderly, I am very reactive to the effects of medicine; thus, I have always worked under the plan of starting with the lowest possible dose of any new medicine, and sometimes I wind up taking less than that.

These are my thoughts for the moment; now I can only hope for the success of all.

After-surgery note: I wish I had added to the list above two items. Because of my lack of muscle mass, my limbs offer no resistance to such things as blood-pressure cuffs, blood-work tourniquets, and manual positionings. My worst pain and a soreness that is still with me arose from the unnatural (to me) manipulation of my right shoulder on the operating table while I was under anesthesia.

Because of my enervated shoulder muscles, even the closure of incisions near my underarms became a major problem. The slightest roughness/lumpishness in that spot created a kind of a speed bump to my already-limited arm motion. I have recently had plastic surgery (under a local) to smooth out my right underarm.

I came through all of the surgery with little, if any, loss of function. Perhaps my arms and shoulders tire more quickly, but I am pleased that they serve me as well as they do. As for the cancer, the pathology report indicates that it was Stage One with negative lymph nodes, which means that it was caught early enough not to require follow-up radiation or chemotherapy. And because it contained no estrogen receptors, I am not even taking Tamoxifen. □

Related resources:

Anesthetic Implications of Poliomyelitis by Joseph D. Tobias, MD; *The American Journal of Anesthesiology*, March/April 1995, pp. 102-104.

New Neuromuscular Blocking Drugs by Jennifer M. Hunter, MB; *The New England Journal of Medicine*, Vol. 332, No. 25, pp. 1691-1699.

New Breathing Problems in Aging Polio Survivors: Respiratory Muscles Weakness

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and had problems maintaining an adequate oxygen level. I was called in because the gynecologist and internist did not understand why the chest x-ray would not clear and why her oxygen level was so low. The first thing I ordered was a pulmonary function test to determine how strong her respiratory muscles actually were.

Pulmonary function tests ... In my opinion, the most accurate is a specific test of muscle strength. Some call it maximum inspiratory pressure. We call it negative inspiratory force. Expiratory strength can be measured by blowing as hard as possible against a resistance. We measure how much force is generated when someone tries to take a breath against an occluded mouthpiece. How hard one struggles to take a breath reveals how strong the respiratory muscles are. These special tests are helpful, easy to do, and they can be done at the bed-side. However, not all hospitals are properly equipped.

Standard respiratory testing involves having a clip placed over the nose while blowing as hard as possible. This measures actual lung volume and the ability to push air out in one second. Results of standard respiratory testing can give an indication of respiratory muscle weakness.

If any of the breathing muscles are weak, lung capacity and ability to expel air are reduced proportionally. It is important to note that with repeated effort most people have a learning curve and will get better results over the first three or four tries. On the contrary, someone with muscle weakness, who is asked to work harder and harder, will get worse with each try. A knowledgeable pulmonologist looking at that pattern will recommend tests to measure respiratory muscle strength.

Representative case ... The individual referred to earlier did have a significant decrease in respiratory muscle strength. The normal amount of pressure generated to breathe against an occlusion is about minus 60 to 70 centimeters of water pressure. She was generating about minus 20. As a matter of fact, no individual with prior neuromuscular disease who has been tested in my practice has done better than minus 26.

Stressors on the breathing system ... There may be no consequences of respiratory muscle weakness at all for someone in the minus 30 to minus 40 category until the breathing system is stressed, and surgery is often the stressor that highlights the fact that one has weak breathing muscles.

Infections also can highlight weak breathing muscles. If some find it difficult to cough, which is another function of the respiratory muscles, and have severe pneumonia, they may have difficulty clearing secretions, trouble maintaining oxygenation, and problems recovering from respiratory infection. Individuals with difficulty coughing due to weak muscles also may have a tendency toward bronchitis.

Medications also may unmask respiratory muscle weakness. Some post-polio individuals who believe they do not have respiratory weakness may take sleeping pills and then cannot cough, or take a deep breath. Others can react the same way to pain medications.

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The respiratory weakness appears with the use of the medication.

Exercise can also be the trigger. Polio survivors who do not recognize their respiratory muscle weakness may live a fairly sedentary life noting that they are short of breath with exercise and then quit exercising. When they are forced into vigorous exercise, their respiratory weakness becomes apparent.

Others who are not aware of any particular breathing problem show problems during sleep when studied. Everyone's tidal volume drops when sleeping, as does the oxygen level. People with respiratory muscle weakness may present initially with problems just during sleep which is why sleep studies are recommended.

If one has weak respiratory muscles and is overweight, the muscles are required to do more work. People with borderline respiratory muscle function may do just fine at a normal weight but may not be able to tolerate an extra 30 pounds. People who are borderline live fairly normal lives. However, they do not handle physiologic stress too well and may develop chronic respiratory insufficiency resulting in exercise limitation, abnormal gas exchange (with low oxygen and a rise in carbon dioxide), and profound oxygen desaturation during sleep which can cause strain on the right side of the heart and possibly cor pulmonale. One can develop acute respiratory failure from respiratory muscle weakness in conjunction with a physiologic stressful event. This situation requires mechanical ventilation immediately.

Other conditions of concern are the ability of the esophagus to function, dysphagia (swallowing problems), and aspiration (taking in of fluid or particles of food in the lung).

Suggestions for management ... Support for people who have weak respiratory muscles includes aggressively treating infections and regularly implementing chest physical therapy which can be done at home when someone has bronchitis. However, when someone has an infection and trouble coughing, more assistance may be needed. Many hospitals do not have the older IPPB (intermittent positive pressure breathing) machine, but the same principle can be employed with intermittent CPAP (continuous positive airway pressure). It is generally prescribed 15 minutes four times a day resulting in considerable improvement in the movement of air in the lungs decreasing atelectasis (small mucus plugs in the lungs).

Another support for respiratory muscle weakness is rest. The breathing muscles can be rested at night by using one of the many types of ventilation assistance. □

Terms Used in Vignettes

CPAP stands for continuous positive airway pressure. Air flows continuously through a hose to a mask over the nose to keep the airway open during sleep. CPAP is used in treating obstructive sleep apnea. Several companies manufacture CPAP machines.

BiPAP® System provides two different pressure levels of air, one for inhalation and a lesser pressure on exhalation. It can provide a timed respiratory rate; can "spontaneously" sense the user's effort to breathe and the pressure changes accordingly to offer a pressure support breath; and can be set at a minimum breathing rate known as a backup rate. It is manufactured by Respironics, Inc., 1001 Murryridge Dr., Murrysville, PA 15668-8550 (800/345-6443).

BiPAP® System is known in the industry as a bi-level pressure device. Other manufacturers make bi-level pressure devices. Companion 320 I/E Bilevel is manufactured by Puritan-Bennett, 4865 Sterling Dr., Boulder, CO 80301 (800/248-0890). Quantam PSV (pressure support ventilator) is manufactured by Healthdyne Technologies, 1255 Kennestone Circle, Marietta, GA 30066 (770/499-1212). It is expected that others will be approved shortly.

BiPAP® Systems and CPAP are assist devices and are not usually used for life support ventilation.

Portable volume ventilators deliver a preset volume of air (the bi-level pressure devices do not). Ventilators can deliver breaths at chosen intervals, whenever an individual wants an additional breath, and synchronized with the individual's breathing effort.

PVV, PLV-100, and PLV-102 are portable volume ventilators manufactured by LIFECARE International, Inc., Park Centre, 1401 West 122nd Ave., Westminster, CO 80234-3421 (800/669-9234).

LP-6, LP-6 Plus, LP-10 are portable volume ventilators manufactured by Aequitron Medical, Inc., 14800 28th Ave., N., Minneapolis, MN 55447-4834 (800/497-4979).

Bear 33 is manufactured by Bear Medical Systems, Inc., 2085 Rustin Ave., Riverside, CA 92507-2437 (800/232-7633).