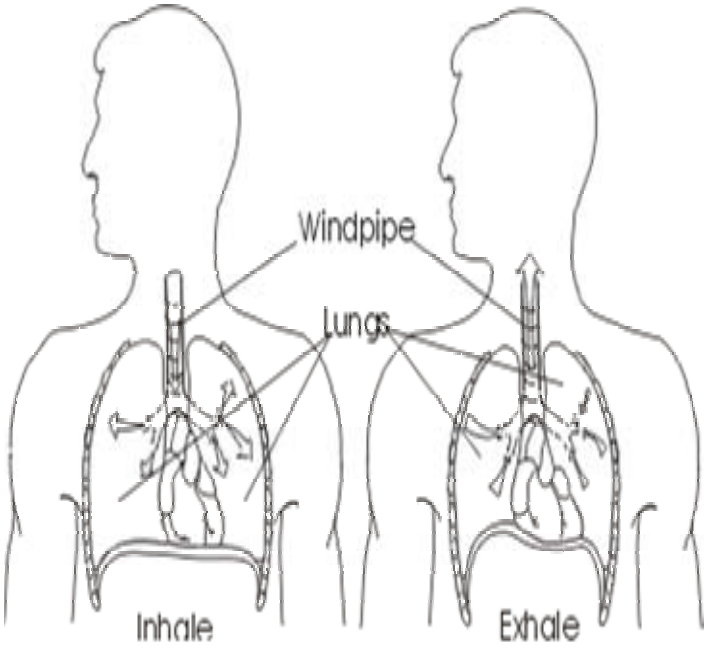
Understanding and Managing Respiratory Complications after SCI

Respiratory System

The respiratory system, also known as the pulmonary system, is used for breathing. The windpipe and lungs are the two main parts of the respiratory system. When you inhale, or breath air in through your mouth or nose, oxygen travels down your windpipe and into your lungs. Your lungs then filter the oxygen and send it through your blood stream to all your body parts. When you breath out, or exhale, you send the left over carbon dioxide out of your body, through your windpipe and out of your mouth or nose.

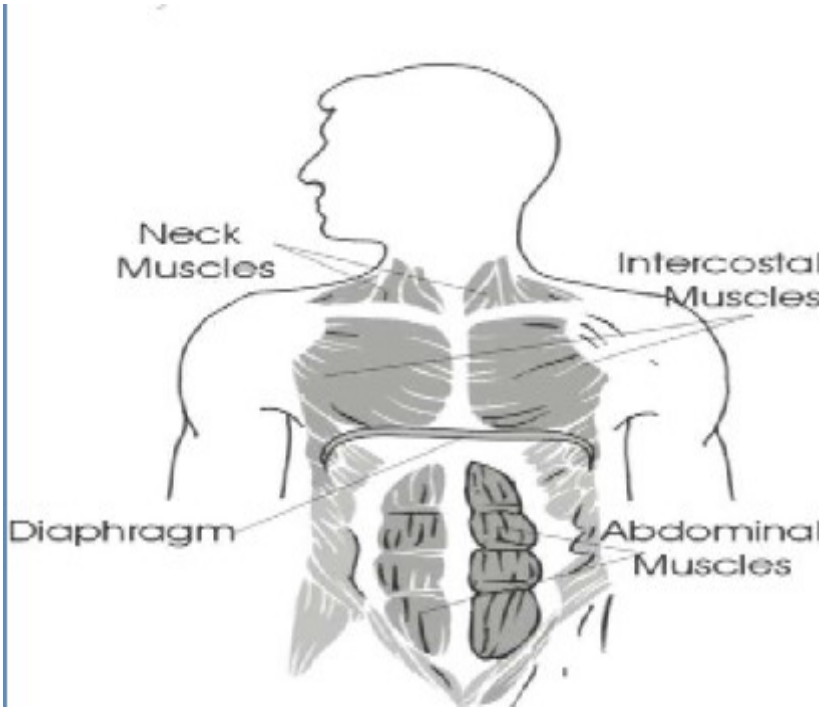


Respiratory Muscles

When you exhale it does not require any effort from the body's muscles. However, you normally use a combination

of four respiratory muscle groups to breath air into your body.

The diaphragm, a strong, dome-shaped muscle that separates the abdominal and chest cavities, is normally the main muscle that you use when you inhale. The intercostal muscles are located between the ribs. These muscles help to expand your ribs as you inhale. The neck muscles normally work to expand your upper chest when inhaling. The abdominal muscles work with these other muscle groups to help you breath deeply and cough.



Role of the Spinal Cord
The brain normally sends signals through nerves in the spinal cord to control the four respiratory muscle groups. When everything is working properly, the pulmonary system and respiratory muscles work together allowing you to breath in and out without much effort. In fact, most people breath without ever thinking about it.

After SCI

The windpipe and lungs are not typically affected by a spinal cord injury. However, respiratory problems may occur when the signals sent from the brain can no longer flow through the spinal cord to control the respiratory muscles.

The amount of muscle control that is lost after a spinal cord injury depends on the level of the injury along with the completeness of the injury. Individuals with injuries below the T12 level do not usually lose any control of the four respiratory muscle groups needed for breathing. This means the respiratory system is not usually affected by injuries in the lumbar or sacral regions of the spinal cord.

Individuals with complete thoracic or cervical injuries do experience a loss of their respiratory muscle control. The higher the level of injury, the greater the loss to the respiratory muscle control.

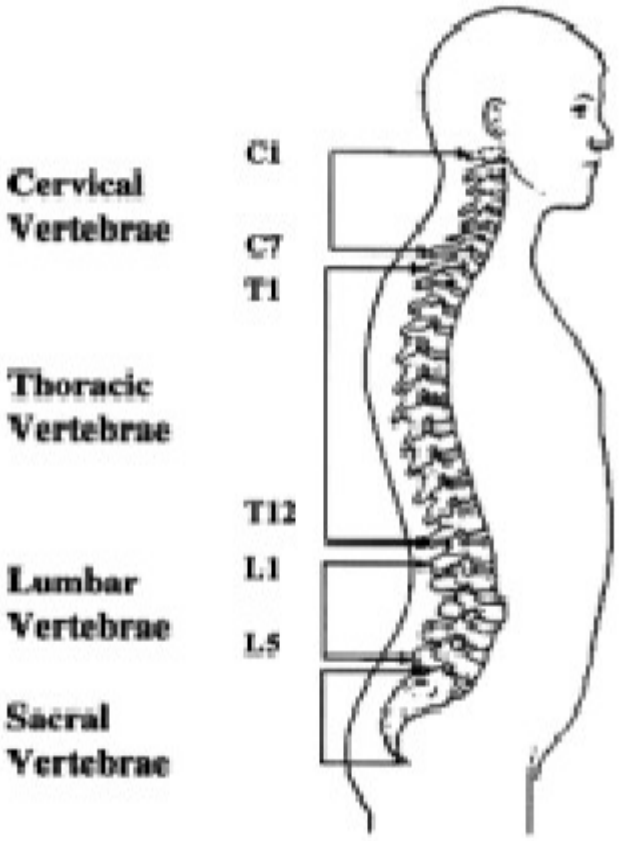
Complete injuries in the thoracic or cervical regions usually result in the permanent loss of respiratory muscle function below the level of injury. However, if that injury is incomplete, it is impossible to predict whether the individual will regain some or all of their respiratory function below the level of injury.

Injuries in the thoracic area (T1-T12) of the spinal cord affect the control of the intercostal and abdominal muscles. A lower level of injury, such as a T10, results in the individual losing a small amount of muscle control. With a higher level of injury, such as a T2, individuals will lose most of their intercostal and abdominal muscle control.

Complete injuries in the cervical region usually result in a total loss of intercostal and abdominal muscle control. Again, the higher the level of injury, the greater the loss of additional muscle control. For example, a complete injury between levels C3 and C5 loses all control of the diaphragm muscles. With a complete injury at level C3 and

higher the individual loses control of all four muscle groups that are needed for breathing. A ventilator is then needed to assist in breathing.

The ventilator does the work of the absent muscles and forces air into the lungs. Many people with a C4 level of injury, and even some people with a C3 level of injury, can eventually breathe without the aid of a ventilator or may only need it for part-time assistance. Those individuals with complete injuries above C3 use a ventilator for full-time assistance.



Respiratory Complications

Individuals with a spinal cord injury are at increased risk for developing respiratory complications. Any loss of respiratory muscle control weakens the pulmonary system, decreases one's lung capacity, and increases respiratory congestion. It does not matter what the level of injury or if

the injury is complete or incomplete. However, the risk for complications is greater for persons with a complete injury and for persons with tetraplegia.

For persons with high level tetraplegia (C5-C1), ventilatory failure is a common complication after injury. The person typically lacks the ability to breathe without assistance. Another common problem is atelectasis. This is when the lungs partially collapse because not enough air is getting into the lungs. All levels of injury are at risk for pulmonary embolism. Pulmonary embolism is a blockage in the blood vessels of the lungs. This is the primary disease of pulmonary circulation and the second leading cause of death for persons with SCI within the first year after their injury. In addition individuals with high tetraplegia (C1-C4) are about 100 times more likely to die from diseases of pulmonary circulation, regardless of time after injury, when compared to the general population (See Chart A). Those individuals with paraplegia (T1-S5) are almost 50 times more likely to die from pulmonary embolism. Ventilatory failure, atelectasis and pulmonary embolism are all very serious, life-threatening respiratory complications. However, pneumonia is the leading cause of death for all persons with spinal cord injury. This is true regardless of your level of injury or how long you have been injured.

Chart A
Standardized Mortality Ratio*
for Diseases of Pulmonary Circulation

Time Since Injury	*SMR
<1 Year	210.0
1 - 5 Years	19.1
> 5 Years	8.9
Injury Level</B.< TD>	*SMR
C1 - C4	105.0
C5 - C8	64.0
T1 - S5	48.6

from National SCI Statistical Center, 1995

Chart B shows that, when compared to the general population, individuals with SCI are more than 80 times more likely to die of pneumonia or the flu within the first year after their injury. Also, persons with high level tetraplegia are about 150 times more likely to die of pneumonia at any time after injury, and persons with paraplegia are more than 10 times more likely to die of pneumonia or flu.

Be aware of the symptoms for pneumonia. They include shortness of breath, having pale skin, a fever, along with a feeling of heavy chest and an increase in congestion. If you have symptoms of pneumonia, call a doctor immediately for advice on treatment.

Chart B
Standardized Mortality Ratio*
for Pneumonia and Influenza

Time Since Injury	*SMR
<1 Year	83.8
1 - 5 Years	26.3
> 5 Years	19.0
Injury Level</B.< TD>	*SMR
C1 - C4	151.7

C5 - C8	58.7
T1 - S5	12.8

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from National SCI Statistical Center, 1995

Prevention of Respiratory Complications
Acute and Rehab Care

Because persons with SCI are more likely to develop respiratory complications within the first year after injury, it is very important to take steps to prevent complications during the acute care and rehabilitation stays.

Treat all symptoms of respiratory complication aggressively to help prevent further complications from developing.
Everyone with SCI should be vaccinated against (pneumococcal) pneumonia. 1
Avoid the buildup of secretion in the lungs. It can be helpful for persons with high level tetraplegia to receive regular treatments with a cough assist machine. Individuals with tracheostomies who are on a ventilator need to have secretions suctioned from their lungs on a regular basis.

Long-term Care

Individuals with SCI should also have an ongoing, life-long plan to help prevent respiratory complications.

Maintain proper posture and mobility. Sit up in your wheelchair everyday and turn regularly in bed to prevent buildup of congestion.

Cough regularly. You can use a machine to help you cough, have someone perform manual assist coughs, or perform self-assist coughs.
Wear an abdominal binder to help assist your intercostal and abdominal muscles.
Follow a healthy diet and manage your weight. Weight management is important because respiratory problems are more likely to occur if you are too underweight or too overweight.
Drink plenty of water. This helps your body in many ways, and water helps to keep congestion from becoming thick and difficult to cough up.
Do not smoke. Smoking not only causes cancer, but other harmful effects include a decrease of oxygen in the blood, an increase in congestion in the chest and windpipe, a reduction in your ability to clear secretions from your lungs, a destruction of lung tissue, and an increase in the risk for respiratory infections such as pneumonia and bronchitis.
Live sensibly. Avoid close contact with people who may have a cold or flu. Avoid areas with dust, smog and other air pollutants.
See a doctor at least once per year. Your doctor may recommend that you get a chest x-ray or a flu shot.
Exercise. Every person with spinal cord injury can benefit from some type of exercise. However, it is important to first talk to your doctor to find the right exercise program for you. Participation in athletics and other cardiovascular activities can improve strength and endurance while helping to keep the pulmonary system strong. If you have a high level of injury or do not like strenuous exercise, it may be helpful to do breathing exercises.

Breathing Exercises

Here are 5 breathing exercises that you can do at least 2 times a day to help your pulmonary system.

Take a deep breath and hold it for a few seconds before slowly breathing out.
Take a deep breath bringing in as much air as you can and as fast as you can before pushing the air out as fast as you can.
Take a deep breath and hold it, take another breath and hold it, and take one more before slowly breathing out.
Take a deep breath in then breath out counting as long and as fast as you can.
If you have a spirometer, use it to both exercise and keep a measurement of your progress.

Sleep Apnea

Sleep apnea is a growing respiratory concern for persons with spinal cord injury. Sleep apnea is a type of breathing disorder. Typically, it is a stop in breathing during sleep. However, apnea can include other respiratory difficulties. Increased research in this area suggests that persons with weakened respiratory muscles may be at high risk for developing sleep apnea, so persons who are older and persons with tetraplegia may be at a very high risk. Symptoms include irregular breathing or snoring, daytime sleepiness, problems with memory or concentration, waking up often during the night, and waking up tired or with a headache. If you think you may have sleep apnea, talk to your doctor for advice on treatment.

Conclusion

A number of respiratory complications can occur after spinal cord injury. This places all individuals at risk for developing complications regardless of level of injury or whether the injury is complete or incomplete. Therefore, it is important to understand these potential respiratory complications and what you can do to help prevent them from developing.