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Incidence and Management of Pulmonary Issues after Vertebral Body Tethering: Risk Factors and Outcomes

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Introduction

Vertebral Body Tethering (VBT) is an innovative and minimally invasive technique used to treat Adolescent Idiopathic Scoliosis (AIS), offering an alternative to traditional spinal fusion surgeries. VBT involves the placement of a flexible tether along the convex side of the spinal curve, which restricts further progression of the curve while still allowing for some spinal growth. This method is gaining popularity due to its potential to preserve spinal motion and prevent the complications associated with fusion surgery, such as reduced spinal mobility and early onset of degenerative changes. While VBT presents several advantages, it is not without risks. One of the most concerning potential complications is the development of pulmonary issues after surgery. The effects on pulmonary function can be significant, as the spine plays a crucial role in respiratory mechanics. This article will explore the incidence of pulmonary problems following VBT, the risk factors that contribute to these complications, and the management strategies currently employed to mitigate these risks. Furthermore, we will discuss the long-term outcomes and the importance of careful patient selection and postoperative care [1].

Description

Vertebral Body Tethering is a relatively recent approach to the correction of scoliosis in patients who are still experiencing spinal growth. It differs from traditional scoliosis surgery, which often involves spinal fusion. In VBT, a flexible cord, usually made of a high-strength polymer, is attached to the vertebrae along the convex side of the curve. The tether is designed to guide spinal growth in a way that reduces the curvature of the spine without fusing the vertebrae together. The primary aim of VBT is to treat scoliosis while preserving the natural motion of the spine. By restricting growth on the curved side of the spine, the tethering technique allows the opposite side to continue growing, gradually straightening the spine over time. VBT is most effective in younger patients who have significant remaining growth potential, typically adolescents with curves between 40 and 65 degrees. It has the advantage of potentially allowing for future spinal growth and avoiding the long-term complications of spinal fusion, such as stiffness, limited mobility, and early onset of arthritis. Despite its benefits, VBT is not suitable for every patient, and there are risks associated with the procedure, particularly concerning pulmonary health. These complications can arise due to the anatomical and functional relationship between the spine and the respiratory system [2].

The spine plays a fundamental role in the mechanics of breathing. The rib cage, which is attached to the thoracic spine, moves during respiration, aiding in the expansion and contraction of the lungs. Any alteration in spinal alignment, particularly in the thoracic region, can impact the biomechanics of the rib cage and, consequently, lung function. Scoliosis, by deforming the spine, can impair the normal motion of the rib cage, leading to restrictive pulmonary defects. In the case of VBT, although the procedure aims to correct spinal deformity, it may also induce changes in the rib cage and thoracic cavity. The tether may limit the movement of the ribs, particularly on the convex side of the curve. Furthermore, the correction of the curve over time may alter the overall thoracic shape, potentially leading to reduced lung capacity, difficulty in chest expansion, and compromised respiratory function. While pulmonary complications after VBT are relatively uncommon, they are significant when they do occur. The incidence of pulmonary problems post-VBT varies across studies and depends on several factors, including the degree of curve, the patient's age, the surgical technique used, and the presence of other underlying health conditions. Several studies suggest that the incidence of pulmonary issues following VBT is low compared to traditional spinal fusion surgeries, where complications such as restrictive lung disease and diminished respiratory function are more common. However, the overall incidence of pulmonary complications after VBT ranges from 1% to 5% in most clinical studies [3].

Effective management of pulmonary complications after VBT requires a multifaceted approach. Early recognition and prompt intervention are critical to minimizing the impact of these issues on a patient's long-term health. For patients experiencing mild to moderate restrictive lung disease, pulmonary rehabilitation is often recommended. This involves exercises designed to improve lung capacity, increase respiratory muscle strength, and enhance overall breathing efficiency. In some cases, respiratory physiotherapy may be necessary to help clear mucus and improve airflow. In more severe cases, patients may require supplemental oxygen therapy to maintain adequate oxygen levels in the blood. This is typically indicated for those with significant pulmonary impairment, and oxygen may be provided either during physical activity or continuously, depending on the severity of the symptoms. Close monitoring of lung function following VBT is essential. This may involve routine spirometry testing to assess Forced Vital Capacity (FVC) and Forced Expiratory Volume (FEV1). If any significant decline in lung function is observed, further interventions, such as increased respiratory support or adjustments to the tether, may be necessary. Encouraging patients to engage in physical therapy and postural exercises can help improve lung function by promoting better alignment of the spine and chest wall. This may also help prevent the development of secondary complications, such as chronic pain or stiffness, which can further affect respiratory function. Since VBT is a relatively new procedure, long-term follow-up is essential to assess the durability of the correction and monitor for any delayed pulmonary complications. Regular follow-up visits allow healthcare providers to track the patient's progress and intervene early if pulmonary issues begin to emerge [4,5].

Conclusion

Vertebral Body Tethering is a promising and less invasive treatment option for adolescent idiopathic scoliosis, with the potential to preserve spinal flexibility and improve quality of life. While pulmonary complications following VBT are relatively uncommon, they can be significant for certain patients. Understanding the risk factors, such as preexisting pulmonary conditions, curve severity, and surgical technique, is crucial to minimizing the chances of postoperative respiratory issues. Additionally, early recognition and a comprehensive management strategy, including pulmonary rehabilitation, oxygen therapy, and long-term monitoring, can greatly improve outcomes

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for patients experiencing pulmonary complications after VBT. With ongoing research and clinical refinement, it is likely that VBT will continue to evolve, becoming a safer and more effective option for scoliosis correction. Ensuring that patients are carefully selected and appropriately monitored can mitigate the risks associated with pulmonary issues, enhancing the overall success of the procedure. As more data becomes available, healthcare providers will be better equipped to manage pulmonary complications and optimize the long-term health of patients undergoing this innovative procedure.

Acknowledgement

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Conflict of Interest

None.

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