

Original article

Evaluation of Respiratory Complications in Patients with Various Neurological Diseases

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Abstract

Background: One of the main causes of death for children with neurological diseases is respiratory problems. The combination of respiratory muscle failure and neurological abnormalities causes breathing and cough reflex disruption, which leads to these problems. Respiratory problems are frequently a result of neurological disorders, including neuromuscular diseases, congenital brain abnormalities, and intellectual disabilities.

Aims and Objectives: To evaluate the respiratory complications in patients with various neurological diseases.

Methods: Eighty adults with neurological disorders who experienced respiratory problems participated in this prospective observational study, which was carried out in a hospital. Medical records were used to gather the data, and expert input ensured its authenticity and correctness. Patient demographics, neurological diagnoses, blood test results, and radiological findings were among the important parameters that were documented. Adult patients over the age of 18 who gave their informed consent and had respiratory issues met the inclusion requirements.

Results: With 70% of cases (56 patients), cerebrovascular accidents (CVA) were found to be the most common neurological disorder. The most frequent respiratory consequence was aspiration pneumonia, which occurred in 72.5% of patients (58 instances). Pneumothorax, shaded half-chest, and pulmonary effusions were less common findings on thoracic CT and chest X-rays, but pulmonary densities and infiltrates were seen in 71.25% of cases (57 individuals).

Conclusion: The study has concluded that the respiratory complications are the most common cause of mortality and morbidity in children with neurological diseases.

Keywords: neurological disease, respiratory complication

Introduction

Respiration-based complications often aid as the prime cause of mortality and fatality in this demographic, are more common in children with neurological ailments. Cerebral matters such as neural-muscular diseases, congenital cerebral irregularities, and intellectual impairments can negatively affect the ability to breathe in multiple aspects. The central and peripheral nervous systems, as well as the structure and function of the respiratory system itself, affect the control over breathing muscles, leading to these problems [1]. Disorders affecting the central nervous system might have profound impacts on the respiratory tract, influencing both the muscular tissues that regulate breathing and the nervous system itself. Impaired motor function affects both conscious and unconscious breathing in children with intellectual disabilities, potentially leading to atypical breathing patterns [2]. Furthermore, impairing muscle tissue may lead to difficulties with respiration, particularly while napping [3]. Under breathing and

ultimately, respiratory breakdown, are the first steps towards the inability to exhale completely out as a consequence of weakening respiratory muscles [4].

The inability to cough effectively is an key determinant of respiratory problems amid youngsters suffering from neurological diseases. In order to clean the breathing ducts from dirt and mucus, coughing is essential for the prevention of respiratory tract infections and other respiratory-related diseases. Repetitive respiratory infections can exacerbate pre-existing pulmonary issues [6], and children with brain injuries are at increased risk for developing weaker coughs as a result of difficulties with the muscle groups that aid in cough production [5]. Sleep-related breathing issues, especially obstructive sleep apnea (OSA), are also common in children with neurological diseases. Children with ailments such as spinal cord injury or hydrocephalus often encounter central insomnia due to brain-stem dysfunction, which obstructs the normal respiratory rhythm during sleep. Moreover, in neurological conditions, obstructive sleep apnea can occur due to closing of nasal passageway during sleep as pharyngeal musculature weakened [8]. Sleep-related respiration problems elevate the likelihood of respiratory distress as the condition worsens [9].

Young people with neurological problems frequently experiences gastroesophageal reflux disease (GERD), which ultimately leads to breathing complications. Gastroesophageal reflux disease (GERD) may result in the continuous expulsion of fluid from the stomach into the breathing passages, leading to continual infections and worsening ailments such as asthmatic bronchitis or influenza [10]. The compromised capacity of swallowing and safeguarding their airways in these young people amplifies the potential of aspiration pneumonia, which is a notable factor in fatality [11]. Scoliosis, a common problem among children with neurological illnesses, often exacerbates respiratory challenges. Persistent scoliosis can deform the thoracic cavity, restricting pulmonary expansion and diminishing pulmonary volumes; hence, it can cause restrictive lung conditions [12]. The mechanical limitation of the lung cells intensifies the pre-existing breathing challenges caused by weakened muscles or compromised central pulmonary regulation [13]. As the curvature of the spine worsens, the pulmonary function deteriorates, leading to chronic respiratory failure in severe cases [14].

There are plenty of variables to consider when it comes to dealing with pulmonary issues in youngsters who have neurological conditions. The greatest hope for these young people is early detection and therapy. Physiotherapy for the chest and non-invasive ventilation (NIV) are common therapies that aid respiration, particularly during the night-time, and facilitate the removal of mucus from the lung cavities, respectively [15]. Children with more serious neurological diseases may require mechanical breathing for extended periods or continuously [16]. Despite improvements in treatment, children with deteriorating brain disorders, such as spinal muscular atrophy and muscular dystrophy, continue to die primarily due to respiratory complications [17]. Sleeping investigations and lung capacity testing offer superior diagnostic methods such as polysomnography that may assist in identifying these young people's breathing problems beforehand, while longevity outcomes still fluctuate [18]. Any further attempts to lessen the severity of respiratory ailments may benefit from studies regarding innovative therapies, such as gene therapy and pharmaceuticals [19].

Methods

Study design

A prospective observational study was conducted in our hospital on 80 patients diagnosed with neurological diseases and developed respiratory complications. The data was collected through the medical records of patients. The patients' history and other details were obtained by duty doctors in the department. This current study utilized the patient's information (age, gender, and whether or not they smoke), the diagnosis of a neurological condition, and the results of blood tests and radiological examinations were used to determine the respiratory problems and neurological disease. The study examines the neurological diseases that resulted in respiratory complications and also the respiratory complications that are associated with neurological diseases. The findings from CT and chest X-rays were also assessed.

Inclusion and exclusion criteria

Adult patients with neurological illnesses who were hospitalized and over the age of 18, and who experienced respiratory difficulties during follow-up care were included in the study. Patients who provide informed consent and are willing to participate in the study were also included. Pregnant individuals, children, and neurological patients who did not have respiratory complications were not included.

Statistical analysis

The study used SPSS 27.0 for effective analysis. The study also used MS Excel for calculating the frequencies and percentages of each parameter. The study used student's t-test for analysis. The level of significance was considered to be $P < 0.05$.

Ethical approval

The patients were given a thorough explanation of the study by the authors. The patients' permissions have been gotten. The concerned hospital's ethical committee has accepted the study's methodology.

Results

In Table 1, the data demonstrate that cerebrovascular accidents (CVA) were the most significant cause of respiratory complications, as evidenced by the asterisk (*) marking its percentage of 70% (56 cases). The p-value of less than 0.05 indicates a statistically significant difference in the frequency of respiratory complications associated with CVA compared to other neurological diseases. Other neurological conditions, such as status epilepticus and traumatic brain injury (TBI), each contributed 6.25% of cases (5 instances). However, these conditions were not as prevalent as CVA. Less common conditions, including Alzheimer's disease, Guillain-Barré syndrome, brain tumours, and encephalitis, ranged between 1.25% and 3.75% of cases, further supporting the statistically significant role of CVA in respiratory complications.

Table 1: Neurological diseases that resulted in respiratory complications

P<0.05

Disease type	Number of cases	Percentage
Status epilepticus	5	6.25%
CVA	56*	70%
Alzheimer's disease	2	2.5%
TBI	5	6.25%
Mental retardation	2	2.5%
Myasthenia gravis	1	1.25%
Gullain barre syndrome	2	2.5%
Brain tumors	3	3.75%
Parkinson's disease	1	1.25%
Encephalitis	3	3.75%

Table 2 presents detailed data on the types of respiratory complications experienced by patients with neurological diseases. Aspiration pneumonia was the most frequent complication, affecting 58 patients, or 72.5% of the study population. This finding is marked as statistically significant (P<0.05), which highlights the strong association between neurological disorders and the development of aspiration pneumonia. Aspiration pneumonia occurs when a person inhales food, stomach acid, or saliva into their lungs, a complication commonly seen in patients with neurological impairments that affect swallowing reflexes.

The second most common complication was pleural effusion, which occurred in 12.5% of cases (10 patients). Pleural effusion refers to the accumulation of fluid in the pleural cavity, which can compress the lungs and make breathing difficult. An additional 10% (8 cases) of patients experienced pneumonia combined with pleural effusion, indicating that a considerable proportion of patients had both infections and fluid buildup, complicating their respiratory health. Pneumothorax, which involves the presence of air in the pleural cavity and can collapse the lung, was rare, observed in only 1.25% of cases (1 patient). Respiratory failure, a more serious and potentially life-threatening condition, was recorded in 3.75% of patients (3 cases). These less frequent complications suggest that

while they are severe, their occurrence in neurological patients is relatively rare compared to aspiration pneumonia and pleural effusion.

The significance of these results ($P < 0.05$) shows that the importance of monitoring for aspiration pneumonia in particular, as it is much more common than other respiratory complications in patients with neurological diseases.

Table 2: The respiratory complications associated with neurological diseases

Disease type	Number of cases	Percentage
Aspiration pneumonia	58*	72.5%
Pneumonia accompanied with pleural effusion	8	10%
Pleural effusion	10*	12.5%
Pneumothorax	1	1.25%
Respiratory failure	3	3.75%

$P < 0.05$

Table 3 outlines the findings from diagnostic imaging, specifically chest X-rays and thoracic CT scans, in patients with respiratory complications linked to neurological diseases. Pulmonary densities and infiltrates were the most frequent radiological findings, observed in 57 patients, or 71.25% of the study population. This is statistically significant ($P < 0.05$), indicating that patients with neurological diseases are highly likely to present with such anomalies. Pulmonary densities and infiltrates generally refer to areas of the lung that appear denser on imaging due to infection or inflammation, commonly associated with pneumonia or other respiratory conditions.

In 10 cases (12.5%), there was an absence of the costophrenic angle, which refers to the blunting or loss of the sharp angle between the diaphragm and the rib cage on a chest X-ray. This finding often suggests the presence of pleural effusion or other fluid in the pleural space, which aligns with the data on pleural effusion from Table 2. Pulmonary densities combined with effusions were noted in 8 patients (10%), further supporting the prevalence of fluid accumulation in the lungs of patients with neurological diseases. This co-occurrence of fluid and infection points to a compounded risk of respiratory failure, particularly in patients who already suffer from compromised neurological function. Less common findings included shaded half-chest, observed in 4 patients (5%), which typically refers to a partial lung collapse or other lung volume loss, and pneumothorax, recorded in just 1 patient (1.25%). The statistical significance of the findings ($P < 0.05$) indicates that pulmonary densities and infiltrates are significantly more common than these rarer conditions.

Therefore, the study found the critical role of diagnostic imaging in identifying respiratory complications in neurological patients. Pulmonary densities, infiltrates, and effusions are frequent and serious findings that warrant

immediate medical attention to prevent further deterioration in respiratory function. The significant difference between the frequencies of these findings and less common complications, such as pneumothorax, reinforces the need for targeted management strategies focusing on these prevalent issues.

Table 3: Findings from respiratory abnormalities computed tomography (CT) and chest X-ray (CXR)

Disease type	Number of cases	Percentage
Pulmonary densities and infiltrates	57*	71.25%
Shaded half-chest	4	5%
Absence of the costophrenic angle	10	12.5%
Pneumothroax	1	1.25%
Pulmonary densities and effusions	8	10%

P<0.05

Discussion

Airways issues are a major stress among individuals with neurological illnesses, frequently resulting in severe illness and mortality. Neurological illnesses such as intellectual disabilities, Duchenne muscular dystrophy, and amyotrophic lateral sclerosis (ALS) can significantly affect the lungs, mostly due to the deterioration of the airway muscles and a disruption of neurological regulation of breath. Prompt assessment and intervention for these problems can enhance outcomes by mitigating the possibility of respiratory distress and improving quality of life [20].

Brain disorders influence the respiratory system in numerous manners, reliant upon the nature and degree of the ailment. Youths with autism spectrum disorders frequently exhibit irregular breathing habits due to impairments in motor function, impacting both voluntarily and autonomic respiration. In neuromuscular illnesses such as Duchenne muscular dystrophy, the gradual deterioration of the lung muscles impairs breathing, especially while you sleep, resulting in a lack of ventilation and ultimately lung failure. The impairment of respiration substantially increases the mortality rate in these individuals [21].

A primary factor that triggers respiratory distress in brain diseases is the impairment of an efficient cough reflex. Coughing is imperative for expelling mucus from the respiratory tract and averting illnesses such as bronchitis. Neurological problems, especially those affecting bulbar muscular activity, frequently diminish the capacity for coughing, rendering persons more susceptible to respiratory tract infections. Such infections can exacerbate pre-existing pulmonary issues and hasten lung deterioration. A prevalent concern is sleeping-disordered breathing, particularly obstructive sleep apnea (OSA). In neuromuscular disorders such as ALS, compromised pharyngeal

muscles may result in airway obstruction during sleep, hence elevating the possibility of obstructive sleep apnea and collapsed breathing [23].

In ailments such as spina bifida, central sleep apnea may arise from cortical dysfunction, which interferes with regular respiratory rhythms during sleeping. As these disorders advance, individuals encounter deteriorating breathing capacity, resulting in chronic hypoventilation and ultimately lung failure. Gastroesophageal reflux disease (GERD) exacerbates respiratory health in neurological individuals. Persistent aspiration of the gut's contents entering the airways can result in persistent infections and exacerbate pre-existing breathing problems such as chronic bronchitis as well as asthma. Numerous patients with neurological disorders experience dysphagia, rendering them more susceptible to aspiration pneumonia, a predominant cause of respiratory infections in this demographic [24].

When evaluating respiratory issues in neurological patients, it is necessary to evaluate them using a combination of clinical assessments and diagnostic tools. Pulmonary function examinations are widely used to determine the capacity of the lungs and the strength of the respiratory muscles. This provides a means of assisting the early detection of poor respiratory function. For the purpose of detecting sleep-related breathing abnormalities, such as obstructive or central sleep apnea, polysomnography is an exceptionally salient diagnostic tool. These evaluations are absolutely necessary in order to devise appropriate therapeutic approaches for the treatment of respiratory dysfunction patients [25]. When dealing with neurological patients who are experiencing respiratory issues, it is necessary to employ a multidisciplinary approach. In order to provide assistance to respiratory muscles that are weakened, non-invasive ventilation (NIV) is a vital component of treatment, particularly during sleep. Neuroinvasive ventilation (NIV) makes it easier to get enough breathing, which reduces the risk of hypoventilation and increases oxygen saturation. When dealing with more complicated circumstances, it may be required to use mechanical respiration, either temporarily during acute illness or permanently in progressing illnesses such as amyotrophic lateral sclerosis (ALS) [26].

In the area of respiratory treatment, chest physiotherapy is an indispensable element. In order to stimulate the clearance of mucus from the lungs, approaches such as postural drainage and percussion are utilized. This leads to reduction in infections and an refinement in pulmonary capabilities. Mechanical cough help devices have the potential to improve coughing effectiveness in individuals who have decreased cough reflexes, hence reducing the chance of mucus collection and the subsequent infections that may result from it. Individuals who suffer from conditions such as scoliosis, which is a common result connected with neuromuscular disorders, could be required to undergo surgical procedures [27]. Scoliosis of a severe nature can cause the thoracic cavity to become deformed, which in turn restricts the expansion of the lungs and leads to restrictive lung disease. In the case of scoliosis, surgical surgery can improve pulmonary capacity and breathing, hence reducing certain aspects of respiratory strain. It is also vital to manage problems such as gastroesophageal reflux disease (GERD) in order to prevent aspiration and improve respiratory health. It is possible that the use of medications like proton pump inhibitors or, in extreme cases, surgical intervention for gastroesophageal reflux disease (GERD) could reduce the incidence of aspiration pneumonia and improve the respiratory state of neurological patients [28].

In conclusion, the diagnosis and management of respiratory issues in people who have neurological complaints are tremendously vital for refining the excellence of life and the consequences over the long term. Identification in a timely way by diagnostic methods such as pulmonary function tests and polysomnography, in combination with remedies such as non-invasive ventilation, chest physiotherapy, cough assistance, and surgical procedures [29], can help to avert the development of respiratory impairment. Investigations that are now being led into ground-breaking treatments, counting as gene therapy and pharmacological interventions, have the latent to further lessen the respirational issues that these patients experience.

Conclusion

The study has concluded that the respiratory complications are the most common cause of mortality and morbidity in children with neurological diseases.

This study emphasizes the important connection between neurological disorders and respiratory issues, with cerebrovascular accidents (CVAs) representing 70% of cases as the primary cause. The most prevalent respiratory problem, aspiration pneumonia, afflicted 72.5% of patients, indicating the considerable risk associated with compromised neurological function on protecting the airway and swallowing. In these patients, respiratory decline is exacerbated by contributing variables such as weaker cough reflex, muscle dysfunction, and breathing difficulties associated to sleep. Pulmonary densities and infiltrates are frequently shown on radiographic results, suggesting a high rate of infection. In order to prevent respiratory failure, the study emphasizes the value of early detection, multidisciplinary management, and interventions such non-invasive ventilation (NIV), chest physical therapy, and mechanical cough aid.

The study's clinical contributions emphasize how critical it is to identify and treat respiratory issues in people suffering from neurological conditions. The study highlights the importance of multimodal methods, such as mechanical cough assistance, chest physical therapy, non-invasive ventilation (NIV), and in extreme situations, surgical procedures like scoliosis correction. These techniques are essential for increasing these patients' ability to breathe, decreasing respiratory infections, and improving their general quality of life. Timely therapies can stop the progression of respiratory failure by utilizing early diagnosis techniques like polysomnography and pulmonary function tests.

Advances in gene therapy and pharmacological therapies, which offer the possibility of better respiratory muscle function and disease modification, will be the main focus of future prospects for managing respiratory problems in neurological patients. Personalized medicine techniques and advancements in non-invasive ventilation devices may improve respiratory therapy that is customized to meet the needs of each patient. Furthermore, there is potential for postponing respiratory failure and enhancing quality of life by improved preventative measures such early rehabilitation, ongoing respiratory monitoring, and proactive management of comorbidities like gastroesophageal reflux disease (GERD). These advancements have the potential to drastically lower morbidity and mortality rates in this susceptible group.

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