https://ijmsweb.com

Indian Journal of Medical Sciences

Original Article

Respiratory complications of neurological diseases

Maya Aldurah[1], Raed Aractingi[1], Hussam Al Bardan[1]

[1]Department of Internal Medicine, College of Medicine, Syrian Private University, Damascus, Syrian Arab Republic.

ABSTRACT

Objectives: This study aims to raise awareness toward early diagnosis, effective treatment, and prevention of respiratory complications in patients with neurological diseases. The goal is to improve patients' overall condition and reduce mortality rates.

Materials and Methods: This study is a prospective observational study conducted at Damascus Hospital, Damascus, Syria, from October 2022 to March 2023. It includes (100) patients diagnosed with neurological diseases who developed respiratory complications. Their ages ranged from 18 to 89 years, with an equal gender distribution. Data analysis was performed using SPSS statistics version 19.

Results: This study revealed that cerebrovascular accidents cause aspiration pneumonia. The most frequent chest X-ray and thoracic computed tomography findings showed pulmonary densities and infiltrates. Subsequently, arterial blood gas results showed type 2 respiratory failure. Many patients experienced regression of respiratory complications, and the mortality rate was low, indicating the efficacy of treatments.

Conclusion: Respiratory complications significantly contribute to mortality in patients with neurological diseases. The study emphasizes the importance of early diagnosis and preventive measures such as elevating the patient's bed and periodic suctioning of secretions. Placing patients in specialized neurological intensive care units for tailored treatment is advised.

Keywords: Neurological diseases, Respiratory complications, Aspiration, Muscle weakness

INTRODUCTION

Muscular weakness is a common representation of various neurological diseases, often leading to a wide aspect of complications. The most common life-threatening complications of neurological diseases are infections and respiratory failure. Cerebrovascular accident (CVA) is a major contributor to respiratory complications, including sleep apnea, aspiration pneumonia, and respiratory failure.[1] Traumatic brain injury (TBI) can be caused by blunt trauma or penetrating injury. Manifestations of TBI include hematomas, concussion, and most commonly hemorrhagic CVA. Respiratory complications are similar to those resulting from a stroke.[2] Status epilepticus causes aspiration during the seizure resulting in aspiration pneumonia. Moreover, breathing dysfunction may lead to sudden unexpected death in epilepsy.[3] Viral encephalitis is often caused by herpes simplex, which often results in coma.[4] Seizures and respiration muscle weakness during the coma cause aspiration pneumonia. Coma necessitates the need for mechanical ventilation, which in the long term, increases the chances of getting infected with hospital-acquired pneumonia.[5] Guillain-Barre syndrome is a rare neurological disease that usually manifests after *Campylobacter jejuni* infection.[6] Bulbar respiratory center failure induces respiratory failure that requires invasive intervention. In addition, weakness of pharyngeal and mastication muscles can cause aspiration leading to pneumonia.[7] Alzheimer's disease manifestations consist of cognitive impairment, muscle weakness, and reflex weakness. In advanced stages, pharyngeal reflex weakness induces aspiration pneumonia which can be fatal in some cases.[8] Parkinson's disease (PD) causes weakness in mastication muscles, appearing as difficulty in chewing food which progresses to aspiration pneumonia. In addition, dyspnea is a common respiratory symptom of PD induced by breathing dysfunction and anxiety.[9] Myasthenia gravis (MG) manifests as muscle weakness, rapid fatigue, ptosis, diplopia, skeletal muscles and respiration muscles weakness, and cough reflex weakness. Consequently, weakness of the cough reflex and respiration muscles results in respiratory failure and/or pneumonia.[10] This study observes the neurological disorders discussed above and their corresponding respiratory complications, their diagnostic

***Corresponding author:** Maya Aldurah, Department of Internal Medicine, College of Medicine, Syrian Private University, Damascus, Syrian Arab Republic. maya.aldurah@gmail.com

Received: 26 April 2023 **Accepted:** 10 December 2023 **EPub Ahead of Print:** 09 January 2024 **Published:** 06 July 2024 **DOI:** 10.25259/IJMS_90_2023

tools, and their management. Provided that, this observation aims to decrease the morbidity and mortality rates and provide a better general state of patients with neurological diseases.

MATERIALS AND METHODS

Study design and methodology

This prospective observational study was conducted at Damascus Hospital, Damascus, Syria, over 6 months from October 2022 to March 2023. This study included 100 patients with a neurological disease diagnosis and developed respiratory complications. Data collection was done by reviewing patients' medical records. The accuracy and validity of the information were ensured since it was written by specialized doctors. The data obtained was patient's data (patient's age, patient's gender, and smoker or non-smoker), neurological disease diagnosis, and respiratory complications based on clinical examination, radiological findings, and blood test results. The inclusion criteria were hospitalized adult patients (aged 18 and above) with neurological diseases who developed respiratory complications while following up on their condition. The respiratory complications were diagnosed through clinical examinations, radiation imaging, and blood tests. Children, neurological patients without respiratory complications, and pregnant women were excluded. No intervention was performed as the type of study is a prospective observational study. The source population included patients admitted to the Department of Neurological Diseases and the intensive care unit at Damascus Hospital.

Data were analyzed using SPSS Statistics version 19.

Ethical considerations

The study maintained patient confidentiality as the identities of the patients and their personal information were not disclosed, focusing on collecting data related to their medical condition only.

RESULTS

This study included 100 patients with a neurological disease diagnosis and developed respiratory complications. Their ages ranged from 18 to 89 years. The gender distribution of patients was 50 males and 50 females. The number of patients who smoked was 38 (23 males and 15 females) and non-smokers were 62. Table 1 presents the neurological disease diagnosis that developed respiratory complications. The clinical diagnosis was made based on the clinical findings upon inspection, palpation, auscultation, and percussion. In addition, radiographic imaging and laboratory testing helped further in the diagnosis. The conducted tests are divided into four categories: Radiographic investigations, arterial blood gas (ABG), oxygen saturation (SpO_2) levels, and C-reactive protein (CRP) levels. Table 2 presents the type of respiratory complications associated with neurological diseases. Various radiographic investigations were carried out including chest-X-ray (CXR) and thoracic computed tomography (CT). Table 3 presents the numbers and the percentages of the CXR and thoracic CT findings.

It was found through CXR and CT imaging that most of the aspiration pneumonia cases were located in the right lung with a percentage of 83%, whereas 17% of the cases were located in the left lung. Regarding partial pressure of oxygen (PaO_2) in the arterial blood analysis, the results were as follows: The percentage of patients who had normal PaO_2 levels was 23%. On the contrary, the percentage of patients who had low PaO_2 levels was 77%. Regarding partial pressure of carbon dioxide ($PaCO_2$) in arterial blood analysis, the

Table 1: Neurological disease diagnosis that developed respiratory complications.

Neurological disease diagnosis that developed respiratory complications	Number of cases	Percentage
CVA	70	70
TBI	7	7
Status epilepticus	7	7
Encephalitis	4	4
Brain tumors	4	4
Alzheimer's disease	2	2
Mental retardation	2	2
Guillain-Barre syndrome	2	2
Parkinson's disease	1	1
Myasthenia gravis	1	1

CVA: Cerebrovascular accident, TBI: Traumatic brain injury

Table 2: The respiratory complications associated with neurological diseases.

Disease type	Number of cases	Percentage
Aspiration pneumonia	73	73
Pleural effusion	13	13
Pneumonia accompanied with pleural effusion	10	10
Respiratory failure	3	3
Pneumothorax	1	1

Table 3: Chest X-ray (CXR) and thoracic computed tomography (CT) findings.

Disease type	Number of cases	Percentage
Pulmonary densities and infiltrates	71	71
Absence of the costophrenic angle	12	12
Pulmonary densities and effusions	11	11
Shaded half-chest	5	5
Pneumothorax	1	1

results were as follows: The percentage of patients who had normal $PaCO_2$ levels was 40%. However, the percentage of patients who had high $PaCO_2$ levels was 60%. Note that the normal ranges are PaO_2 (75–100) mmHg and PCO_3 (35–45) mmHg.[11]

Regarding SpO_2 assessment, the results were as follows: The percentage of patients who had normal SpO_2 levels was 21%. However, the percentage of patients who had insufficient SpO_2 was 30%, whereas for those who had decreased SpO_2, the percentage was 20%. Subsequently, the rest of the percentages for critical status, severe hypoxia, and acute danger to life were 11%, 10%, and 8%, respectively. Reference values of SpO_2 were normal $SpO_{2:}$ 98–100%, insufficient $SpO_{2:}$ 95–97%, decreased $SpO_{2:}$ 90–94%, critical <90%, severe hypoxia <80%, and acute danger to life <70%.[12]

Regarding CRP levels, all values were high and ranged between 13.4 and 348 mg/dL. Note that the normal range for CRP should be <0.3 mg/dL.[13]

The treatments that were administered were divided into three groups: Physical, pharmacological, and interventional therapies. Physical therapies that were conducted include chest physical therapy, secretions suctioning, postural drainage, and placement of nasal cannula or respiratory face mask. Pharmacological treatments used are antibiotics such as ceftriaxone: ROSS, levofloxacin: LEVO, vancomycin: VANCONEX, C bactam: C BACTAM, clindamycin: CLINDO PLUS, and metronidazole: FLAGYL; proton pump inhibitors such as omeprazole: RISEK; anticoagulants such as enoxaparin sodium: ENOXIR; antiplatelets such as aspirin: AVENZOR; loop diuretics such as furosemide: LASIX; rehydration fluids such as normal saline; analgesic and antipyretic drugs such as acetaminophen: CETAMOL; glucocorticoids such as prednisone: PREDLON; calcium channel blockers such as amlodipine: DIPIVASC; and HMG-CoA reductase inhibitors such as rosuvastatin: ROSOVA. Interventional therapies that have been used were intubation with mechanical ventilation or tracheostomy with mechanical ventilation. Chest physical therapy, ceftriaxone, levofloxacin, omeprazole, aspirin, furosemide, acetaminophen, rosuvastatin, valproate sodium and/or levetiracetam, normal saline, and respiratory face mask were administered for non-critical cases. Intubation with mechanical ventilation or tracheostomy with mechanical ventilation was conducted in critical cases. The treatment plan mentioned above was expected to treat the respiratory complications, relieve neurological symptoms, and stabilize and improve the patient's overall condition. Respiratory complications recovered in 70% of the patients with a stable and improved general state. On the other hand, 20% of the patients did not improve and suffered instability. Unfortunately, 10% of patients died due to respiratory complications.

DISCUSSION

CVA had the highest percentage of occurrence of respiratory complications. CVA has a wide range of causes and multiple predispositions.[1] Aspiration pneumonia had the highest occurrence rate among respiratory complications. Neurological diseases often lead to the failure of physiological defense mechanisms essential to maintaining respiratory airway integrity. Factors that contribute to develop aspiration pneumonia include respiration, pharyngeal, and mastication muscle weakness as well as immobility, since the patient is most often asleep or unconscious, which increases the chances of aspiration. Furthermore, tracheal intubation escalates the opportunity of acquiring aspiration pneumonia.

Pleural effusion, pneumothorax, and respiratory failure are less common since muscle weakness is the most common manifestation of all neurological diseases. However, muscle weakness does not have a role in these diseases' development that is why they occur less in neurological diseases. Moreover, these diseases typically develop in the advanced stages of neurological diseases when the patient's overall condition deteriorates.

Regarding imaging results, pulmonary densities and infiltrates were the most common findings as they are typical presentations in aspiration pneumonia. The rest of the radiographic findings were less common and were seen in critical, serious, and rare respiratory diseases.

The right lung had a higher incidence of pneumonia than the left lung due to the physiological anatomy of the right bronchus, which is higher and more vertical in position, shorter in length, and wider in diameter than the left bronchus. Subsequently, the right lung is more exposed to aspiration, leading to a higher rate of infections.

ABG results indicated that most patients had low levels of PaO_2 and high levels of $PaCO_2$. This illustrates that most patients had type 2 respiratory failure. In such a manner, this is a normal outcome of a neurological disease since type 2 is usually caused by extrapulmonary diseases.

SpO_2 levels were low in most patients because they suffered from different levels of pneumonia, pleural effusion, pneumothorax, and pulmonary failure. These diseases contribute to various mechanisms causing hypoxia. These mechanisms include hypoventilation, ventilation-perfusion mismatch, and right-to-left shunt.[14]

The body's reaction to any inflammation is by increasing CRP levels in the bloodstream. This clarifies the high CRP levels in this study.

Prevention protocols recommended by this study include suctioning secretions regularly and positioning the bed at a 30°–45° angle to prevent secretions build up and aspiration. In addition, the patient should undergo nothing by mouth

protocol and receive a nasogastric tube insertion. Subsequently, intubation is required if the Glasgow Coma Scale equals 8 or less.[15] Early antithrombotic prevention from pulmonary embolism is recommended, but it is a contraindication for hemorrhagic CVA patients. However, compression stockings and intermittent pneumatic compression devices can also help prevent pulmonary embolisms. Unfortunately, they are not available in our country.

Regarding early diagnosis, regular clinical assessments, including complete blood count, ABG, and CRP levels, are recommended. CXR should be done for patients with abnormal clinical assessments and laboratory testing to confirm the diagnosis and start the treatment. This study suggests that these patients should receive special care and should be placed in a specialized neurological intensive care unit.

The study faced limitations such as difficulties in obtaining patient information from hard copy files and obstacles in acknowledging the sequence of events that led the patient to this status. In addition, the inability to undergo required scans because of resource limitations and the unavailability of advanced imaging techniques and devices. Furthermore, there were difficulties locating the patients since they were not present in a specialized intensive care unit, rather they were displaced.

The Italian study titled "practical approach to respiratory emergencies in neurological diseases"[16] shares numerous similarities and results with this study. Both studies concluded that pneumonia is the most common respiratory complication of neurological diseases. This emphasizes the reliability and inclusivity of investigations done in this study. It also shows the importance of early diagnosis of pneumonia in high-risk patients and immediate treatment.

Both studies concluded that CVA is the most common neurological disease associated with pneumonia. Taking into account the time difference between both studies, this demonstrates a lack of awareness toward early diagnosis and prevention of pneumonia in CVA patients over the years. This amplifies the importance of this study in raising awareness of these neglected life-threatening complications.

Mortality rates are notably high due to respiratory complications; this indicates that they cause death in neurological disease patients more than the disease itself. This study highlights the significance of regular investigations and prolonged prevention of these complications to decrease mortality rates in these patients.

CONCLUSION

This study proved that the most common cause of death in patients with neurological diseases is respiratory complications. It manifested that early diagnosis and treatment of these complications maintain the stability of the patient's general state and reduce their mortality rates. In addition, it identified the most common and most efficient treatment plans that can be administered to control and treat these complications. Respiratory complications pose a significant threat to the health of patients with neurological diseases. Early diagnosis, prevention, and effective treatment are vital to improving patient outcomes. Preventive measures, specialized care units, and tailored treatments help mitigate mortality rates. Consequently, this study underscores the best examinations and analyses that must be conducted to diagnose these complications accurately. This ensures that patients will not be exposed to expensive and high-risk tests without proven benefits. In conclusion, this study aims to raise awareness about the necessity of periodic investigations for these complications to avoid their occurrence and deterioration of the patient's health.

Ethical approval

The research/study complied with the Helsinki Declaration of 1964.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Zhang Y, Parikh A, Qian S. Migraine and stroke. Stroke Vasc Neurol 2017;2:160-7.
2. Galgano M, Toshkezi G, Qiu X, Russell T, Chin L, Zhao LR. Traumatic brain injury: Current treatment strategies and future endeavors. Cell Transplant 2017;26:1118-30.
3. Innes JA, Maxwell Simon RJ. In: Walker BR, Colledge NR, editors. Davidson's essentials of medicine. 22nd ed. Edinburgh, Amsterdam: Elsevier; 2011. p. 1159.
4. Innes JA, Maxwell Simon RJ. In: Walker BR, Colledge NR, editors. Davidson's essentials of medicine. 22nd ed. Edinburgh,

Amsterdam: Elsevier; 2011. p. 1205.
5. Venkatesan A, Murphy OC. Viral encephalitis. Neurol Clin 2018;36:705-24.
6. Saeed ML, Baloch BK, Mahmud SN, Khan MT, Qureshi MS, Shad ZS, *et al*. Role of anti-Ganglioside antibodies in the diagnosis of Guillain-Barré syndrome as an alternate investigation. Cureus 2019;11:e4625.
7. Fokke C, van den Berg B, Drenthen J, Walgaard C, van Doorn PA, Jacobs BC. Diagnosis of Guillain-Barré syndrome and validation of Brighton criteria. Brain 2014;137:33-43.
8. Lane CA, Hardy J, Schott JM. Alzheimer's disease. Eur J Neurol 2018;25:59-70.
9. Innes JA, Maxwell Simon RJ. In: Walker BR, Colledge NR, editors. Davidson's essentials of medicine. 22nd ed. Edinburgh, Amsterdam: Elsevier; 2011. p. 1194-7.
10. Gilhus NE. Myasthenia gravis. N Engl J Med 2016;375:2570-81.
11. Castro D, Keenaghan M. Arterial blood gas. National library of medicine. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK536919 [Last accessed on 2023 Aug 25].
12. Schade M. Oxygen saturation: Normal values and measurement. Cosinuss. Available from: https://www.cosinuss.com/en/measured-data/vital-signs/oxygen-saturation [Last accessed on 2021 Feb 25].
13. Nehring SM, Goyal A, Patel BC. C reactive protein. U.S. National library of medicine. In: StatPearls. Treasure Island, FL: StatPearls Publishing. Available from: https://www.ncbi.nlm.nih.gov/books/NBK441843 [Last accessed on 2022 Jul 18].
14. Bhutta BS, Alghoula F, Berim I. Hypoxia. National library of medicine. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482316 [Last accessed on 2023 Aug 25].
15. Duncan R, Thakore S. Decreased Glasgow coma scale score does not mandate endotracheal intubation in the emergency department. J Emerg Med 2009;37:451-5.
16. Racca F, Vianello A, Mongini T, Ruggeri P, Versaci A, Vita GL, *et al*. Practical approach to respiratory emergencies in neurological diseases. Neurol Sci 2020;41:497-508.

How to cite this article: Aldurah M, Aractingi R, Al Bardan H. Respiratory complications of neurological diseases. Indian J Med Sci. 2024;76:78-82. doi: 10.25259/IJMS_90_2023