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Research

A Prospective Study on Use of Corticosteroids Therapy in The Treatment of Lower Respiratory Tract Infections in Tertiary Care Hospital

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Abstract

Introduction: Lower Respiratory Tract Infections are one of the major global health problems leading to high morbidity and mortality, especially in children, elderly and immune compromised persons. Lower respiratory tract infection is defined as infections of airway and lung structures within the area below the larynx, causing involvement of the trachea, bronchi, bronchioles, and alveoli. The clinical conditions of lower respiratory tract infections are most often caused by microorganisms such as Streptococcus pneumoniae and Haemophiles influenzae; viruses such as influenza and respiratory syncytial virus; and sometimes fungi. LRTIs comprise most of the common illnesses such as pneumonia, acute bronchitis, bronchiolitis, and sometimes exacerbations of chronic respiratory diseases like chronic obstructive pulmonary disease.

Methodology: A prospective observational study involving analysis of inpatients and outpatients of pulmonology department diagnosed with pulmonary disease with other comorbid conditions, using patient data collection form for a study period of 6 months.

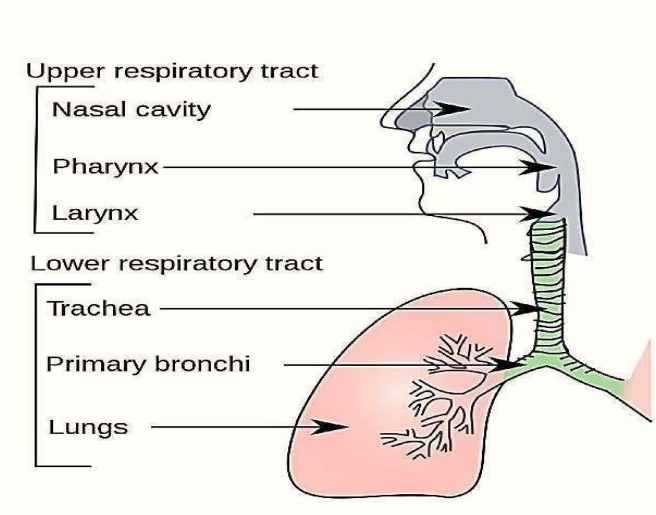
Results: A 6 months study of 120 pulmonary disease patients (66 males, 54 females) found that corticosteroids therapy, particularly formoterol fumarate and hydrocortisone, was most frequently administered (87%). Bronchodilators (levo salbutamol and ipratropium bromide) antibiotics (sulbactam, cefoperazone and clarithromycin) and antacids (pantoprazole and magnesium oxide) were also commonly prescribed. Majority of patients had comorbid conditions like diabetes and hypertension with the age ranging between 51-70 years old.

Conclusion: The study analyzed 120 pulmonary patients, shown high use of corticosteroid (87%). Corticosteroids found useful in reducing inflammation of Asthma and Chronic obstructive pulmonary disease, but required careful management due to side effects. Their widespread use highlights their importance, but future research should assess long-term outcomes and potential risks for better treatment strategies.

Keywords: Corticosteroids, Bronchodilators, Antibiotics, Antacids

INTRODUCTION

Lower respiratory tract infection is defined as infections of airway and lung structures within the area below the larynx, causing involvement of the trachea, bronchi, bronchioles, and alveoli. The clinical conditions of LRTIs are most often caused by microorganisms such as Streptococcus pneumoniae and Haemophiles influenzae; viruses such as influenza and respiratory syncytial virus; and sometimes fungi. LRTIs comprise most of the common illnesses such as pneumonia, acute bronchitis, bronchiolitis, and sometimes exacerbations of chronic respiratory diseases like chronic obstructive pulmonary disease. Complications like respiratory failure and sepsis can follow untreated infections. The diagnostic regime generally comprises the history, physical examination, imaging studies, and laboratory tests, while the treatment is specific depending upon the etiological agent and may include antibiotics, antivirals, and supportive care. Preventive measures such as vaccination, hand washing, and cessation of smoking play a major role in the worldwide burden reduction of lower respiratory tract infections.



CLINICAL MANIFESTATIONS

- Cough (productive or dry)
- Fever and chills
- Chest pain
- Shortness of breath
- Fatigue and muscle aches
- Confusion
- Sore throat
- Low-grade fever
- Wheezing and chest tightness
- Rapid, shallow breathing
- Night sweats

PATHOPHYSIOLOGY

Pathogen Entry
(Inhalation, aspiration, upper airway spread)
t
Initial Colonization
(Pathogens settle on airway epithelium)
t
Immune Activation
(Epithelial cells release cytokines → Macrophages + Neutrophils recruited → Mucociliary clearance)
t
Inflammatory Response
(Cytokines & chemokines → Immune cell infiltration → Toxic agents released → Tissue damage begins)

↓

Lung Tissue Damage

(Pulmonary edema → Alveolar consolidation → ↓ Compliance → Hypoxia & Hypercapnia → Breathing difficulty)

↓

Complications

(Sepsis, ARDS, pleural effusion, lung abscess)

↓

Resolution / Chronic Effects

(Healing or fibrosis → ↓ Lung function → Risk of chronic diseases like COPD, asthma)

DIAGNOSIS

Clinical Evaluation

Diagnosis starts with patient history: symptoms like cough, fever, pleuritic chest pain, and breathlessness. Risk factors (e.g., smoking, COPD, asthma, immunosuppression) are considered. Physical exam includes auscultation for crackles, wheezing, or diminished breath sounds indicating infection or inflammation.

Imaging

Chest X-ray is the first-line imaging to detect consolidation, infiltrates, or effusion—signs of pneumonia or infection. CT scan offers more detailed imaging in complex or unresolved cases (e.g., abscess, fungal or atypical infections).

Microbiological Testing

Sputum samples are analyzed by Gram stain and culture to detect bacterial pathogens. PCR tests and rapid antigen assays confirm viral infections like influenza, RSV, or SARS-CoV-2. AFB staining and TB PCR identify tuberculosis. Fungal stains and cultures help detect pathogens like *Aspergillus* or *Pneumocystis* in immune compromised patients.

Pulmonary Function Tests (PFTs)

Useful in distinguishing LRTI from chronic obstructive conditions. COPD or asthma exacerbations are identified via spirometry or PEFR (Peak Expiratory Flow Rate) to assess airflow limitation.

Other Diagnostic Tools

- **Bronchoscopy:** Direct visualization and BAL sample collection in non-resolving or severe cases.
- **Pleural Fluid Analysis:** Conducted during thoracentesis to rule out empyema or parapneumonic effusion.
- **Arterial Blood Gas (ABG):** Assesses oxygenation and respiratory status, especially in severe infections.
- **Biomarkers:** Elevated CRP and procalcitonin levels suggest bacterial infections over viral.
- **TB & Fungal Testing:** TST/IGRA for tuberculosis; fungal serology for suspected invasive fungal infections

TREATMENT

Antibiotic Therapy for Bacterial LRTIs:

The first-line treatment for bacterial LRTIs such as pneumonia is almost always antibiotics. The choice of antibiotic therapy is therefore guided by suspected pathogens, underlying comorbidities of the patient, and whether the infection is community-acquired or hospital acquired.

Antiviral Therapy for Viral LRTIs:

Antiviral agents, such as oseltamivir (Tamiflu) or zanamivir (Relenza), are used, particularly if treatment is initiated within the first 48 hours of the onset of symptoms, in order to shorten the duration of the illness or diminish the severity of the infection. In severe cases of COVID-19, the antiviral remdesivir and monoclonal antibodies may be used to reduce viral replication.

Fungal Infection Management:

Fungal infection management involves antifungal therapy for clinically relevant LRTIs from fungal infections. Various agents like Aspergillus, Histoplasma, or Coccidioides may cause fungal pneumonia.

Supportive Care:

With bronchodilator nebulization (salbutamol, ipratropium), obstruction is relieved in cases of bronchitis or COPD exacerbations. For severe infections requiring airway support, mechanical ventilation or non-invasive ventilation such as CPAP or BiPAP may be indicated.

Steroids and Anti-inflammatory Medications:

Corticosteroids undergo selective use in severe lower respiratory tract infections (LRTIs) if considerable inflammation is involved. The use of prednisolone and methylprednisolone during exacerbations of chronic

obstructive pulmonary disease (COPD) helps in the reduction of airway inflammation and improvement of lung function.

Prophylactic and Preventive Measures:
Hand hygiene promoting mechanisms such as continuous hand washing, applying alcohol based sanitizer, as well as putting on masks, would prevent the further spread of pathogens. Smoking cessation will mostly reduce the risk of chronic respiratory diseases, while protection from poor indoor air quality and exposure to pollutants will starkly complement the protection of the lungs. Exercises and a normal immune system are two additional ways to provide protection against respiratory infections.

Treatment of Complications:
Cardiac complications in the form of arrhythmias may need use of antiarrhythmic drugs or electrical cardio version as deemed necessary. Antifungal therapy will be started for secondary fungal infections. Proper management of comorbidities such as COPD or asthma is also very important to prevent recurrent infections.

USE OF CORTICOSTEROIDS IN THE TREATMENT OF LRTI

Corticosteroids mimic the action of naturally occurring hormones from the adrenal glands. These pharmacological agents exert significant anti-inflammatory and immunosuppressive effects and thus find clinical utility in treating a variety of conditions, Lower Respiratory Tract Infections (LRTIs) being one. These encompass a variety of infections ranging from pneumonia and bronchitis all the way to exacerbations of chronic conditions such as chronic obstructive pulmonary disease (COPD). In these types of infections, inflammation in the respiratory system can significantly harm lung tissue and impair breathing. The main use of corticosteroids in such conditions is lessening the inflammatory response, which maintains patent airways and, therefore, good respiratory function. Such is not always the case regarding corticosteroids in LRTIs, as context often plays a significant role in their applicability among select patient populations and specific infections. They have been well documented in the treatment of viral pneumonia, COPD exacerbations, and ARDS; however, one cannot overlook the danger of secondary infections.

CORTICOSTEROIDS – CLASSIFICATION

Classification	Corticosteroid Type	Examples	Duration of Action	Potency
Duration of Action	Short-acting Corticosteroids	Hydrocortisone, Cortisone	Short (8-12 hours)	Low to Medium Potency
	Intermediate-acting Corticosteroids	Prednisolone, Methylprednisolone	Intermediate (12-36 hours)	Medium Potency
	Long-acting Corticosteroids	Dexamethasone, Betamethasone	Long (36-72 hours)	High Potency
Potency	Low Potency Corticosteroids	Hydrocortisone, Cortisone	Varies	Low
	Medium Potency Corticosteroids	Prednisolone, Prednisone	Varies	Medium
	High Potency Corticosteroids	Dexamethasone, Betamethasone, Methylprednisolone	Varies	High
Chemical Structure	Glucocorticoids	Prednisolone, Methylprednisolone, Dexamethasone, Betamethasone	Varies	Varies
	Mineralocorticoids	Fludrocortisone, Aldosterone	Varies	Low to Medium Potency [22]

MECHANISM OF ACTION

Corticosteroids are potent anti-inflammatory agents that exert their effects primarily through interactions with the glucocorticoid receptor (GR). Once inside the cell, corticosteroids bind to GRs in the cytoplasm to form a complex that translocates into the nucleus. This complex influences gene expression by interacting with glucocorticoid response elements (GREs) on DNA. Corticosteroids up regulate anti-inflammatory genes, such as those coding for annexin-1 and lipocortin-1, which inhibit the enzyme phospholipase A2—an essential component in the synthesis of inflammatory mediators. Simultaneously, corticosteroids suppress the transcription of pro-inflammatory genes, including those coding for cytokines like TNF-α, IL-1, IL-6, chemokines, and enzymes like

COX-2. In addition to gene regulation, corticosteroids inhibit the production of prostaglandins and leukotrienes by reducing arachidonic acid synthesis. They also stabilize cell membranes of mast cells and granulocytes, preventing the release of histamine and other inflammatory substances. Furthermore, corticosteroids suppress immune function by reducing the activity of T-lymphocytes and macrophages. These combined actions make corticosteroids effective in managing a wide range of inflammatory, allergic, and autoimmune disorders by both controlling inflammation and dampening immune responses.

SIDE EFFECTS

Corticosteroids are widely used anti-inflammatory agents that act primarily through the glucocorticoid receptor (GR). After entering cells, they bind to GRs in the cytoplasm, forming a complex that moves into the nucleus to regulate gene transcription. This process increases the expression of anti-inflammatory proteins like annexin-1 and lipocortin-1 while suppressing pro- inflammatory cytokines such as TNF-α, IL-1, IL-6, and COX-2. Additionally, corticosteroids inhibit phospholipase A2, reducing the synthesis of prostaglandins and leukotriene's key mediators of inflammation. They also stabilize cellular membranes, preventing the release of histamine and other inflammatory substances, and suppress immune cell activity, which is especially useful in autoimmune and allergic conditions.

However, long-term or high-dose corticosteroid use can lead to significant adverse effects across multiple body systems. The immune system is suppressed, increasing infection risk. Endocrine disturbances include adrenal suppression and Cushing's syndrome. Metabolic effects involve weight gain, fluid retention, and electrolyte imbalances. Cardiovascular risks include hypertension and thromboembolism. The musculoskeletal system may suffer from osteoporosis, fractures, and muscle wasting. Gastrointestinal complications such as ulcers and bleeding are common, as are neuropsychiatric effects like mood swings and insomnia.

RISKS AND LIMITATIONS OF CORTICOSTEROID USE IN LRTIS

They can worsen existing conditions like diabetes, hypertension, and osteoporosis by causing hyperglycemia, fluid retention, and bone loss. Long-term use is associated with adverse effects including Cushing's syndrome, adrenal suppression, and gastrointestinal ulcers, especially when combined with NSAIDs. Inappropriate use in viral infections may suppress natural immune defenses and delay proper treatment. Corticosteroids also increase the risk of thromboembolism, particularly in immobilized or high-risk patients. Careful monitoring and appropriate prescribing are essential to reduce these risks.

METHODOLOGY

The study is prospective and observational.

Source of data and material

- Patient data collection form
- Patient case files

Inclusion criteria

- Patients ages 20-80 years old
- Patients with or without a history of pulmonary disease.
- Patients of gender male and female

Exclusion criteria

- Pediatrics patients
- Pregnant and lactating women
- Patient with multiple comorbidities

Method of collection

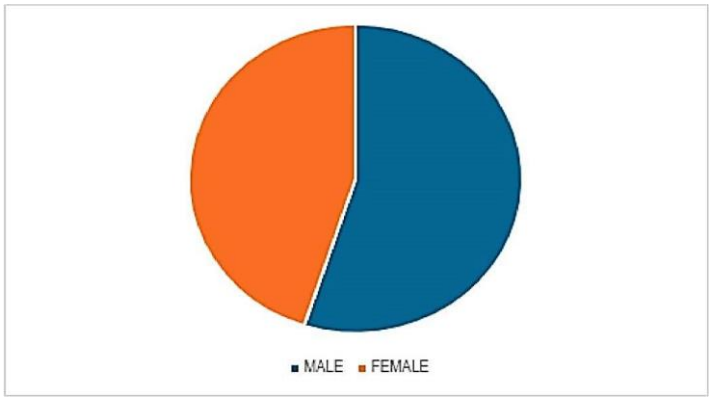
- Data collection
- Medication chart

Study procedure

This is an observational study to know the better understanding of disease. The data collection form was prepared and used. This form mainly contains the demographic details of the patient and medication chart. Study was conducted at Care hospital. All information relevant to the study was collected at the time of admission till the date of review follow up and the data was analyzed after entering into Microsoft excel sheet and frequency tables were calculated using suitable method for statistical analysis.

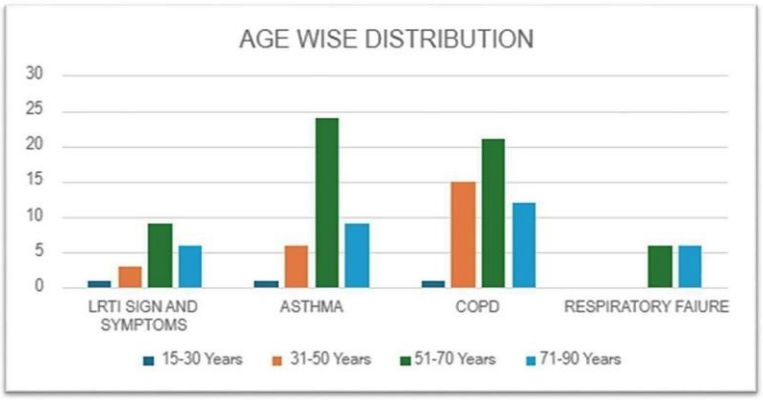
RESULTS

GENDER WISE DISTRIBUTION



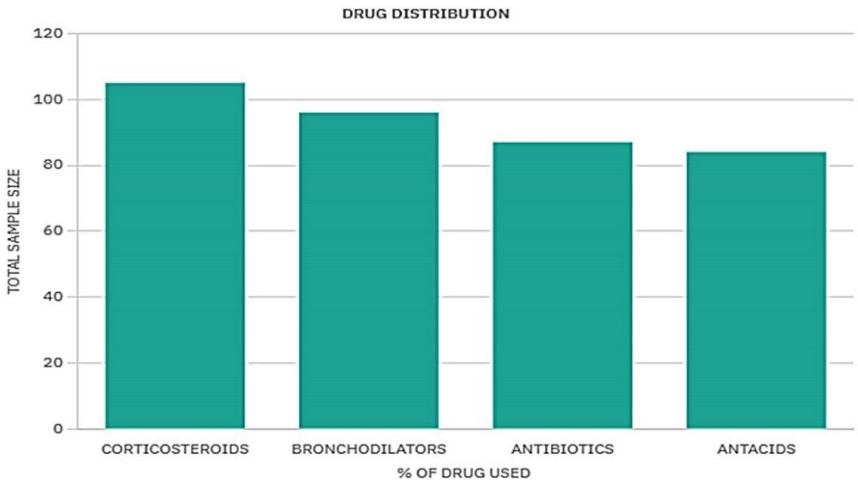
Among the total patients included in the study, the number of male patients were 66 (55%) and female patients were 54 (45%)

AGE WISE DISTRIBUTION



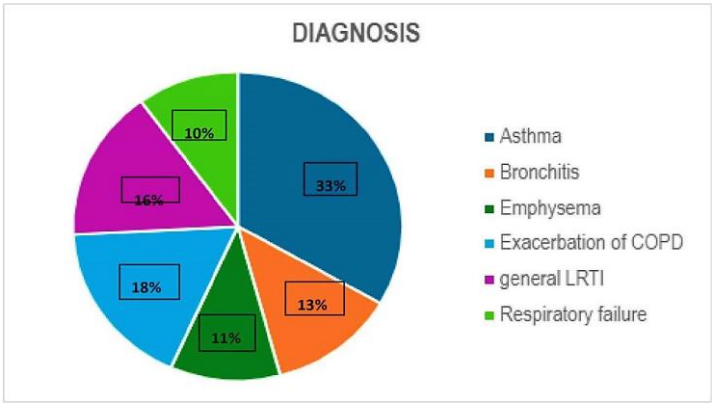
A high incidence of asthma among patients aged 31-50 years was observed, whereas patients aged 15-30 years exhibited a lower incidence of LRTI signs and symptoms

PROFILE OF PRESCRIBED MEDICATIONS



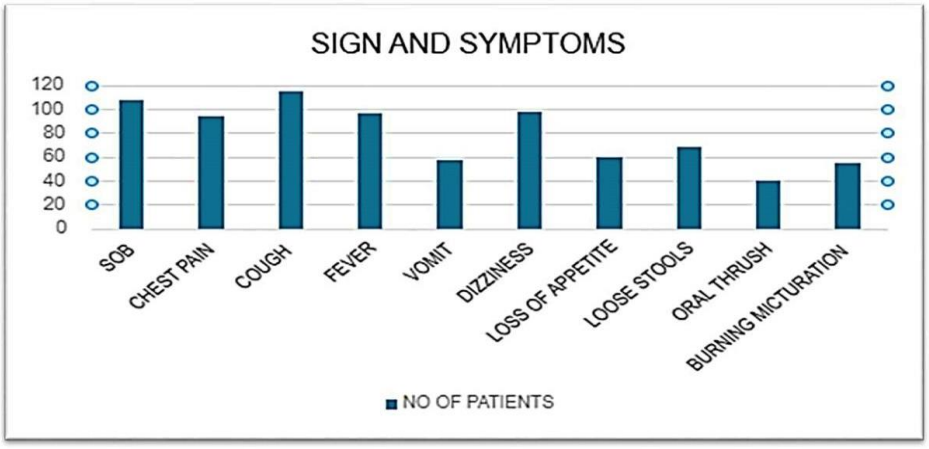
Corticosteroids therapy was 87%, Bronchodilators therapy was 80%, Antibiotics therapy was 72% and Antacid therapy was 70% among LRTI patients

DIAGNOSIS OF PULMONARY DISEASES (LRTI)



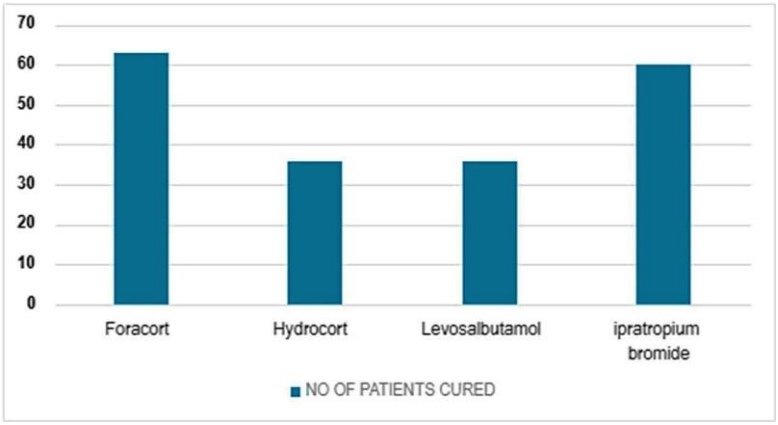
Asthma was the most common comorbidity (33%) among LRTI patients, while respiratory failure was the least common (10%)

PREVALENCE OF SIGNS AND SYMPTOMS OF LRTI



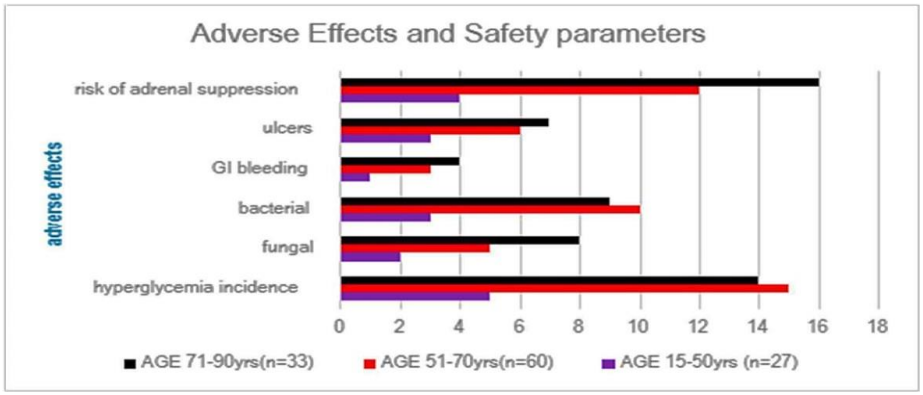
Most of the patients suffered from symptoms of shortness of breath, Chest pain, cough, and dizziness followed by fever, vomiting, loss of appetite, and other less frequent symptoms

EFFECT OF CORTICOSTEROIDS AND BRONCHODILATORS IN TREATING LOWER RESPIRATORY TRACT INFECTIONS



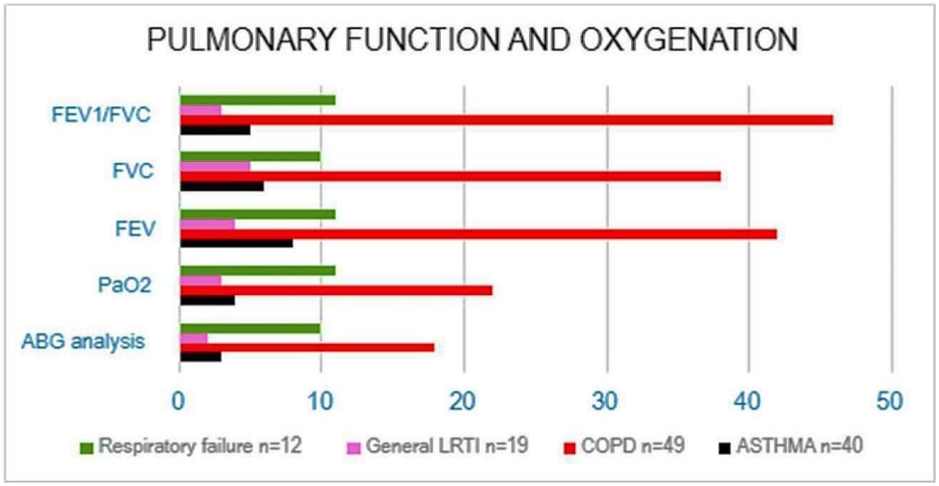
It was observed that doses of Foracort were much more effective than that of Hydrocort in patients receiving treatment for LRTI

ADVERSE EFFECTS AND SAFETY PARAMETERS



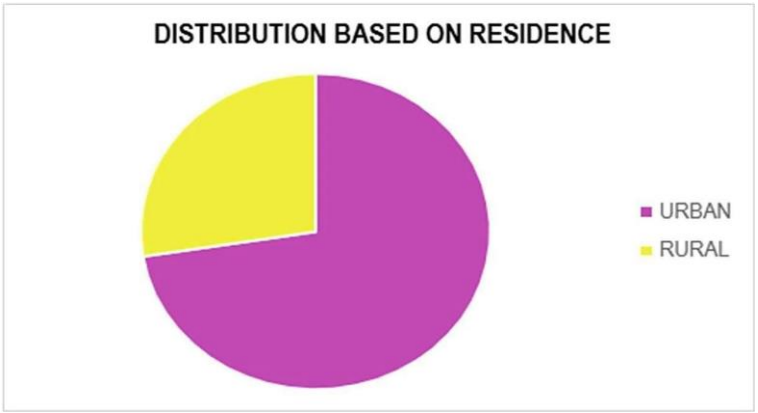
Risk of adrenal suppression was the most common adverse effect among patients aged 71-90 years, whereas for patients aged 15-50 years exhibited less adverse effects of GI bleeding

PULMONARY FUNCTIONS AND OXYGENATION PARAMETERS



FEV1/FVC was commonly used in COPD patients, while ABG analysis was rarely used in general LRTI patients

DISTRIBUTION OF PATIENTS BASED ON RESIDENCE



Patients residing in urban areas (73%) had a higher risk of developing LRTI compared to those living in rural areas (27%)

DISCUSSIONS

In our six-month study, 120 patients were observed at a multi-specialty hospital in Hyderabad. The majority of the patients were male (66) 55% and female (54) 45%. Among the 120 enrolled patients, the age range was 15 to 90 years, the most affected individuals age was ranging between the 51–70 years. We found that 40.8% of the patients had chronic obstructive pulmonary disease (COPD), 33.3% had asthma, and 15.8% exhibited signs and symptoms of lower respiratory tract infection and 10.1% presented with respiratory failure. In terms of signs and symptoms, 89.1% presented with shortness of breath, 78.3% with chest pain, 95.85% with cough, 80% with fever, 47.5% with vomiting, 50% with loss of appetite, 56.6% with loose stools, 45.8% with burning micturition, 33.3% with oral thrush and 81.6% with dizziness. In terms of diagnosis, 33.3% of patients were diagnosed with asthma, 17.5% with COPD exacerbation, 12.5% with bronchitis, and 10.8% with emphysema. In our study we administered corticosteroids in 105 patients and 87% were cured, bronchodilators was administered in 96 patients and 80% were cured, antibiotics was administered in 87 patients and 72% were cured and antacids were administered in 84 patients and 70% of them were cured. Regarding treatment outcomes, 87% of patients were cured with corticosteroid therapy, 80% responded to bronchodilator therapy, 72% were treated successfully with antibiotics, and 70% recovered with antacid therapy. Based on residence we found that 73% of the patients residing in urban areas and 27% of the patients residing in rural areas were affected with lower respiratory tract infections In our study we found that COPD and respiratory failure show the severe pulmonary Impairment with significantly lower FEV1, FVC, FEV1/FVC ratio with Hypoxemia and Acidosis present.

CONCLUSION

The present study analyzed 120 patients with pulmonary diseases over a six month period, focusing on gender distribution, age demographics, disease prevalence, and prescribed treatments. It was observed that pulmonary diseases were more prevalent in males (55%) than females (45%), with the highest incidence occurring in the 51-70 years age group, highlighting that middle-aged and elderly individuals are at greater risk. Among the pulmonary conditions, asthma (33%) was the most frequently diagnosed, followed by COPD and its subtypes, while respiratory failure (10%) was the least common but represented the most severe cases.

The study also revealed that corticosteroid therapy was the most prescribed treatment, administered to 87% of patients, followed by bronchodilators (80%), antibiotics (72%), and antacids (70%). The widespread use of corticosteroids suggests their crucial role in managing inflammation associated with lower respiratory tract infections, asthma, and COPD. Bronchodilators were frequently used to relieve airway obstruction, while antibiotics played a key role in treating secondary infections. A significant proportion of patients had comorbid conditions such as diabetes and hypertension, indicating the necessity of a comprehensive treatment approach to address both pulmonary and systemic health issues.

In conclusion, the findings of this study emphasize the high burden of pulmonary diseases among older adults and the reliance on corticosteroid-based therapies for disease management. The presence of comorbid conditions further underscores the need for an integrated and multidisciplinary approach to treatment. Future studies focusing on long term patient outcomes and treatment efficacy would be valuable in optimizing pulmonary disease management strategies.

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