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Clinical Phenotypes and Lung Function Patterns in Severe Asthma

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Abstract

Conducted on a cohort of 150 patients followed at the Respiratory Diseases Department of the 20 August 1953 Hospital in Casablanca between 2019 and 2023, this retrospective and analytical study outlines the profile of severe asthma in a Moroccan referral center. The study population has a mean age of 36 years with a female predominance (58%) and high exposure to environmental humidity (46%), while the clinical profile is dominated by allergic rhinitis (56%) and gastroesophageal reflux disease (26%). Functionally, the study reveals severe bronchial obstruction with a mean FEV1 of 54% and, alarmingly, an irreversible obstructive ventilatory defect in 68% of cases, confirming the significance of airway remodeling and the difficulty of control (64% uncontrolled patients), which justifies a multidisciplinary therapeutic approach including biological therapies.

Introduction

Asthma is a heterogeneous chronic inflammatory disease of the airways, characterized by a wide range of clinical and biological phenotypes. Within this spectrum, severe asthma represents a significant clinical challenge and a major public health concern. It is defined as a subgroup of asthma that remains uncontrolled despite adherence to optimized therapy—including high-dose inhaled corticosteroids combined with a second controller—and the management of contributory factors, or asthma that worsens when high-dose treatment is tapered [1].

Although it affects a minority of the total asthmatic population (approximately 5% to 10%), the impact of severe asthma is disproportionately high. It contributes significantly to the 455,000 annual asthma-related deaths worldwide and accounts for nearly $300 billion in global healthcare costs [2]. These patients often experience frequent, life-threatening exacerbations and carry a heavy burden of comorbidities, such as allergic rhinitis, obesity, and gastroesophageal reflux disease, which further complicate management and impair quality of life [3].

In the Moroccan context, the clinical and functional landscape of severe asthma remains insufficiently documented. Identifying the specific characteristics of these patients is essential for optimizing therapeutic strategies and implementing precision medicine, such as targeted biological therapies. This study aims to describe the clinical profile and spirometric characteristics of a cohort of 150 patients followed for severe asthma in a specialized respiratory department in Casablanca [1, 4].

Patients and Methods

This research was designed as a retrospective, descriptive, and analytical study. The primary objective was to characterize the clinical and functional landscape of severe asthma within a specialized hospital setting.

Study Setting and Population

The study was conducted at the Respiratory Diseases Department of the 20 August 1953 Hospital in Casablanca, Morocco. The study period spanned from October 2019 to May 2023. A total of **150 patients** were included in the final analysis. All included participants were diagnosed with severe asthma, defined as asthma that remains uncontrolled despite the management of comorbidities and the use of high-dose inhaled corticosteroids combined with a second controller, or asthma that requires such high-dose treatment to maintain control.

Data Collection

Clinical data were systematically collected from the patients' medical records using a standardized

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data extraction form. The parameters recorded included:

- **Demographics:** Age, gender, and socioeconomic status.
- **Toxic and Environmental Exposure:** History of active or passive smoking, exposure to humidity, and contact with domestic animals.
- **Clinical History:** Age of asthma onset, duration of the disease, and personal or family history of atopy.
- **Comorbidities:** Presence of allergic rhinitis, conjunctivitis, gastroesophageal reflux disease (GERD), nasal polyposis, and obesity.
- **Disease Management:** Current therapeutic regimens and assessment of asthma control levels.

Respiratory Functional Assessment

Lung function was evaluated through spirometry. The key functional metrics analyzed were:

Forced Expiratory Volume in 1 second (FEV1): Measured as a percentage of the predicted value.

Reversibility Testing: A bronchodilation test was performed to evaluate the degree of reversibility of the airflow obstruction. A non-reversible defect was defined as the persistence of an obstructive pattern after bronchodilator administration, indicating potential airway remodeling.

Results

Demographic Profile and Environmental Exposures

The study included a total of **150 patients** diagnosed with severe asthma. The demographic analysis revealed a relatively young population with a **mean age of 36 years**. A significant **female predominance** was observed, with women representing **58%** of the cohort.

Regarding toxic habits and environmental factors, **12.6%** of patients were active smokers, while **34%** reported history of passive smoking. Environmental triggers were highly prevalent: **46%** of the participants lived or worked in humid environments, and **18%** were in regular contact with domestic animals.

Clinical Characteristics and Comorbidities

The clinical presentation was marked by a strong association with other atopic manifestations. The distribution of major comorbidities is detailed in the table below:

Asthma Control and History of Exacerbations

Asthma control was assessed using the Asthma Control Test (ACT). The results indicated a high burden of disease:

- **Uncontrolled asthma:** 64%.

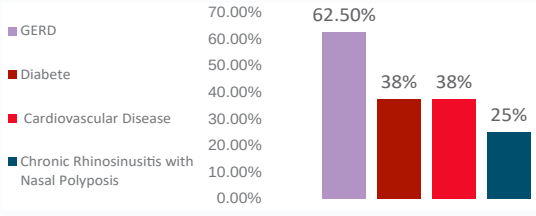

Figure 1: Prevalence of Associated Comorbidities.

Table 1: Mean Spirometric Parameters.

Parameter	Mean Value
FEV1 (% predicted)	54%
FEV1/FVC Ratio	0.58

- **Partially controlled asthma:** 36%.

The cohort experienced an average of **2.4 severe exacerbations per year**. Furthermore, the severity of these episodes was underlined by the fact that **42%** of the patients required at least one hospitalization during the study period.

Functional Respiratory Profile

Spirometric evaluations provided critical insights into the functional impairment of the patients. The mean **FEV1** (Forced Expiratory Volume in 1 second) was recorded at **54% of the predicted value**, reflecting a severe obstructive ventilatory defect. The mean **FEV1/FVC ratio (Tiffeneau Index)** was **0.58**.

A key finding in the functional assessment was the degree of irreversibility. **68%** of the patients exhibited a non-reversible obstructive defect after bronchodilator administration, suggesting the presence of established airway remodeling in a large majority of the cohort.

Discussion

The findings of our study, based on a cohort of 150 patients, provide a detailed clinical and functional mapping of severe asthma in a Moroccan hospital setting. These results align with international observations while highlighting specific regional characteristics.

Demographic Trends: The Female Predominance

The mean age of 36 years and the strong female predominance (58%) observed in our study are consistent with the global literature on severe asthma. According to the GINA guidelines [1] and the TENOR study [6], severe asthma is more frequently observed in adult women, whereas childhood asthma tends to be more prevalent in males. This shift is often attributed to hormonal influences and different environmental exposure patterns in adulthood [6].

The Burden of Comorbidities

Our cohort exhibited a high prevalence of comorbidities, notably allergic rhinitis (56%) and gastroesophageal reflux disease (GERD) (26%). These figures closely mirror the results reported by Chung et al. in the ERS/ATS guidelines [3], which emphasize that comorbidities are not just incidental findings but key drivers of asthma severity and poor control. Obesity, present in 22% of our patients, is also a recognized independent risk factor for severe, corticosteroid-resistant asthma phenotypes [7].

Challenges in Asthma Control and Exacerbations

With 64% of our patients categorized as "uncontrolled," our study confirms the difficulty of managing severe asthma even in specialized settings. The high rate of severe exacerbations (2.4 per year) and the significant hospitalization rate (42%) are major indicators of the disease's morbidity. Similar findings were reported in the ENFUMOSA study [8], which highlighted that severe asthmatics are at a much higher risk for life-threatening events compared to those with mild-to-moderate disease. This high frequency of exacerbations suggests a persistent inflammatory state that is not fully suppressed by conventional high-dose inhaled therapy [1, 3].

Functional Impairment and Airway Remodeling

Spirometry in our study revealed a mean FEV1 of 54% and a Tiffeneau ratio of 0.58, characterizing a severe obstructive ventilatory defect. Most importantly, the high rate of irreversible obstruction (68%) strongly suggests established airway remodeling. As documented by Postma et al. [5], chronic inflammation in severe asthma leads to structural changes, including subepithelial fibrosis and smooth muscle hypertrophy, which result in fixed airflow limitation. This degree of functional decline is a hallmark of severe phenotypes and underscores the need for early intervention and potentially, the use of biological therapies targeting specific inflammatory pathways [1, 9].

Environmental Impact

The impact of environmental factors in our study—such as exposure to humidity (46%) and passive smoking (34%)—is a critical finding. These factors are known to act as persistent triggers that exacerbate airway inflammation and reduce the efficacy of inhaled corticosteroids [10]. In the North African context, humidity and poor housing conditions remain significant barriers to achieving optimal asthma control [1].

Conclusion

Severe asthma, although affecting a small percentage of the asthmatic population, represents a major challenge due to its clinical morbidity and functional impact. Our study of 150 patients confirms that this condition is characterized by a significant female predominance, a high burden of atopic comorbidities—primarily allergic rhinitis—and poor disease control despite optimized therapy.

The functional profile is marked by severe airflow obstruction (mean FEV1 of 54%) and a high rate of irreversibility (68%), highlighting the importance of airway remodeling in these patients. Furthermore, the frequency of severe exacerbations and hospitalizations underscores the need for a multidimensional management approach.

Early identification of these phenotypes and a systematic search for treatable traits, such as environmental triggers (humidity) and comorbidities (obesity, GERD), are essential. For patients remaining uncontrolled, the introduction of targeted biological therapies offers a promising perspective to reduce the reliance on oral corticosteroids and improve long-term prognosis.

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