

## Case study

### **Episodic Shortness of Breath: A Case of Bronchospasm in an 18 Year Old Girl**

#### Abstract

Asthma is a long-term heterogeneous inflammatory condition of the airways. It is marked by shortness of breath, wheezing, intermittent cough and bronchial hyperreactivity. It has several phenotypes and people living with asthma have atopy. Asthma can occur at any age. However, it is more common in males before puberty; then, has equal sex ratio by adulthood.

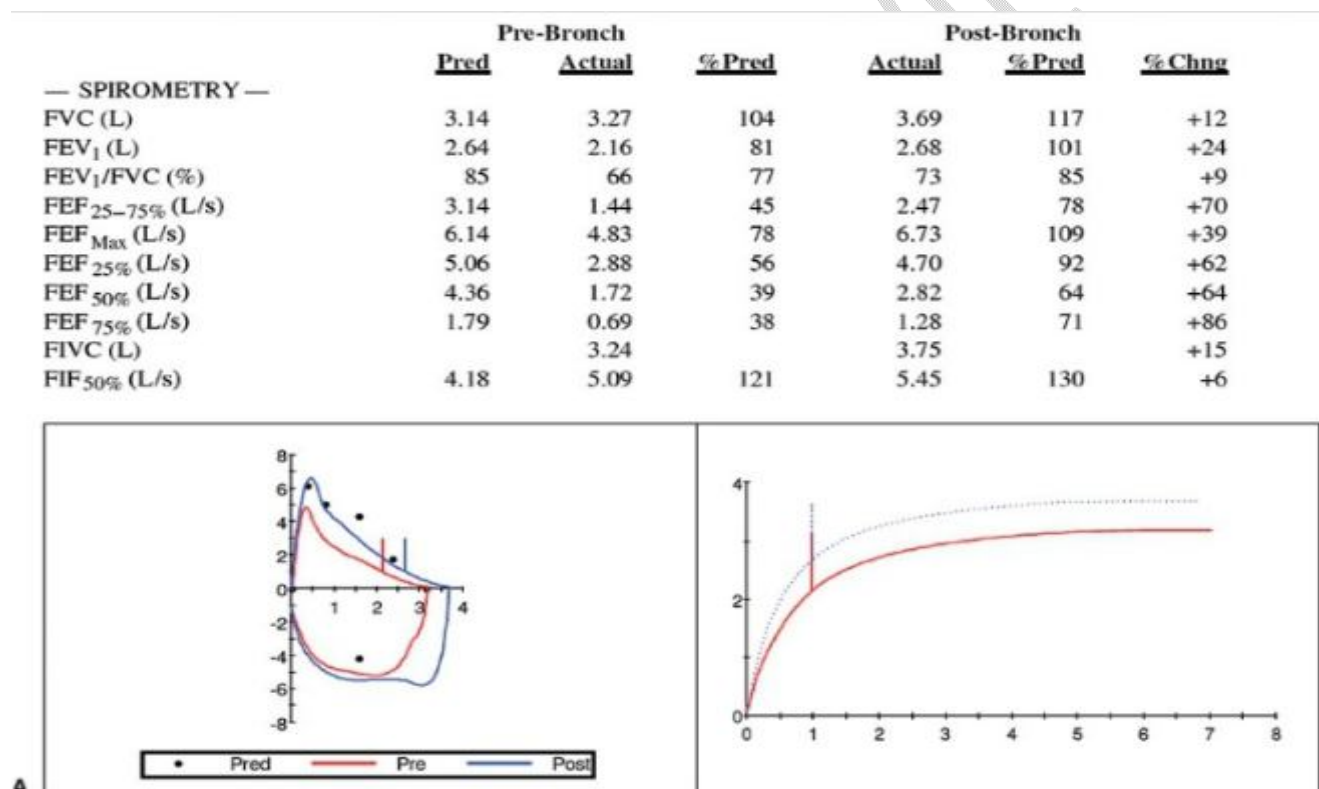
**Keywords: bronchospasm, intermittent asthma, hyperinflation, bronchodilators.**

#### Introduction

Bronchospasm refers to the sudden constriction of the smooth muscle of the bronchi [1]. It leads to a temporary narrowing of the airways. The constriction occurs in asthma, anaphylaxis, chronic bronchitis, and emphysema [2]. Wheezing, chest tightness, coughing, and difficulty in breathing are the classical manifestations. Management of patients with the above symptoms require immediate use of bronchodilators as they reopen the airways and give lungs relief from spasms [3]. Bronchial asthma is a chronic disease affecting the respiratory system [4]. With more than 260 million people affected worldwide, it is one of the most prevalent chronic illnesses [5]. Asthma prevalence in different age groups varies widely worldwide, ranging from about 14% among children to about 8% among adults between 18 and 45 [6,7]. Children and adults alike suffer from bronchial asthma. In spite of the fact that some pediatric patients lead a normal life, about 46% of them have poorly controlled diseases [8]. It is a long-term inflammatory disease causing airway hyperactivity which leads to respiratory difficulties [9,1]. Several allergens, irritants, and triggers can lead to airway reactivity. These include pests, pollen, cold air, smoke inhalation, pet dander, and cleaning chemicals. It is still unclear what causes bronchial asthma, but genetic predisposition is a major factor to be considered [9]. The manifestations of asthma vary, it includes symptoms (worse at night) like breathing difficulty especially during exhalation, coughing, wheezing, and feeling of heaviness in the chest region [10]. Using the Asthma Symptom Utility Index (ASUI), symptoms can be reliably detected [11]. Asthma care is a lifelong process. While there is no cure, proper treatment tailored to the patient's individual needs and patient adherence to treatment results in a favourable outcome. The Global Initiative for Asthma (GINA) guidelines for treatment recommend that this may reduce the frequency of exacerbations and enable adequate control of symptoms [12]. The education of patients once an asthma diagnosis has been made is crucial [13]. Even when the patient feels better, proper medication administration and use are key to controlling symptoms [14,15].

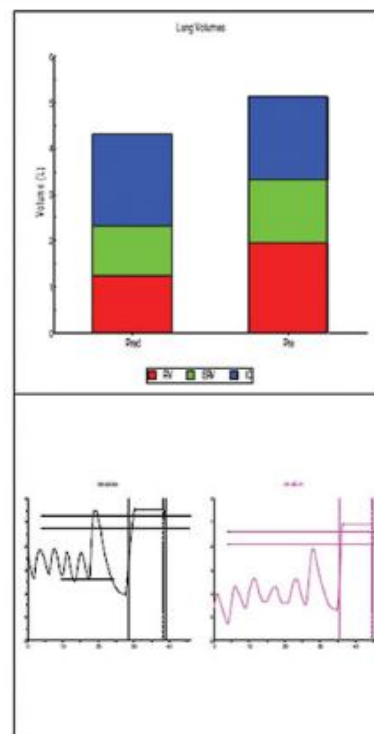
## Case presentation

An 18 year old girl presents on account of intermittent dyspnea of 3 months duration. This complaint started with an upper respiratory tract infection. She finds it difficult to get breath following mild exertion and she has a sudden period of coughing. She complains that her breath produces a whistle-like sound at irregular intervals. She felt better after using her friend's albuterol inhaler and she is wondering if she is actually suffering from bronchial asthma. On examination, she breaths with no difficulty at 15 times/min and her SPO<sub>2</sub> measures at 96% on room air. On auscultation, her lungs are clear and there was no added sound.



**Fig. 1A.** Lung function tests in a patient with suspected asthma (A) The forced expiratory Volume (FEV<sub>1</sub>) is within normal range; however, the tiffeneau-pinelli index and the forced mid-expiratory flow are low [16]. This assessment was done before and after bronchodilation with flow-volume loops and graph of FVC. After bronchodilation, there is a better effect in the peripheral airways; this is represented by forced mid-expiratory flow (B) The residual volume is increased which is suggestive of hyperinflation and air trapping. The transfer factor for carbon monoxide is normal. In summary: hyperinflation, obstruction of the airways, and improvement with beta-2 againsts are in keeping with the diagnosis of asthma [16].

|                                     | Pre-Bronch  |               |              | Post-Bronch   |              |              |
|-------------------------------------|-------------|---------------|--------------|---------------|--------------|--------------|
|                                     | <u>Pred</u> | <u>Actual</u> | <u>%Pred</u> | <u>Actual</u> | <u>%Pred</u> | <u>%Chng</u> |
| — LUNG VOLUMES —                    |             |               |              |               |              |              |
| SVC (L)                             | 3.14        | 3.17          | 101          |               |              |              |
| TLC (Pleth) (L)                     | 4.30        | 5.12          | 119          |               |              |              |
| RV (Pleth) (L)                      | 1.23        | 1.95          | 158          |               |              |              |
| RV/TLC (Pleth) (%)                  | 29          | 38            | 131          |               |              |              |
| TGV (L)                             | 2.32        | 3.33          | 143          |               |              |              |
| Raw (cmH <sub>2</sub> O/L/s)        | 1.86        | 3.71          | 199          |               |              |              |
| ERV (L)                             | 1.16        | 1.38          | 118          |               |              |              |
| IC (L)                              | 1.98        | 1.79          | 90           |               |              |              |
| — DIFFUSION —                       |             |               |              |               |              |              |
| DLCOunc (mL/min/mm H <sub>2</sub> ) | 17.53       | 27.25         | 155          |               |              |              |
| DLCOcor (mL/min/mm H <sub>2</sub> ) | 17.53       |               |              |               |              |              |
| VA (L)                              | 4.30        | 5.11          | 118          |               |              |              |
| DL/VA (mL/min/mm Hg)                | 4.08        | 5.33          | 130          |               |              |              |



B

Fig. 1B. (A) The forced expiratory Volume (FEV1) is within normal range; however, the tiffeneau-pinelli index and the forced mid-expiratory flow are low [16]. This assessment was done before and after bronchodilation with flow-volume loops and graph of FVC. After bronchodilation, there is a better effect in the peripheral airways; this is represented by forced mid-expiratory flow (B) The residual volume is increased which is suggestive of hyperinflation and air trapping. The transfer factor for carbon monoxide is normal. In summary: hyperinflation, obstruction of the airways, and improvement with beta-2 agonists are in keeping with the diagnosis of asthma [16].

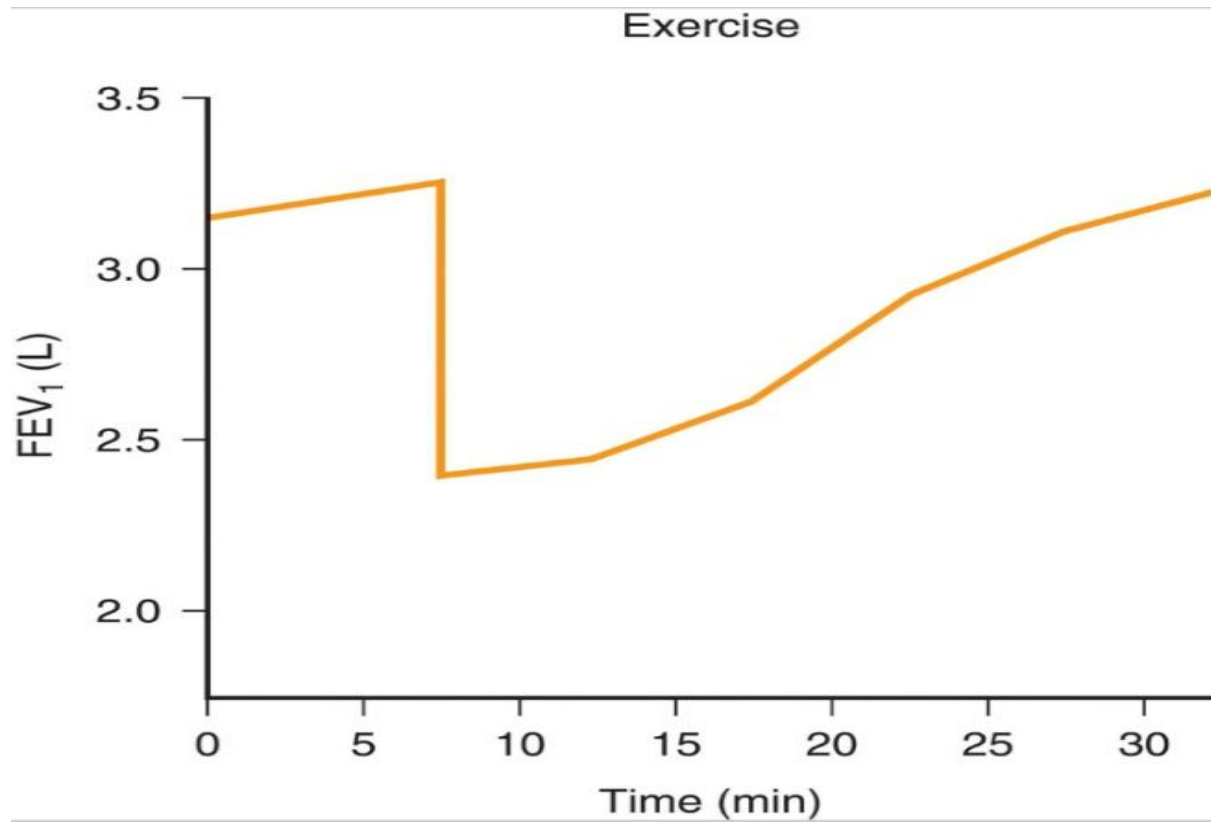


Fig. 2. There is a quick decrease in FEV1, accompanied by progressive recovery. The photograph shows FEV1 in a patient with sports-induced asthma [17].

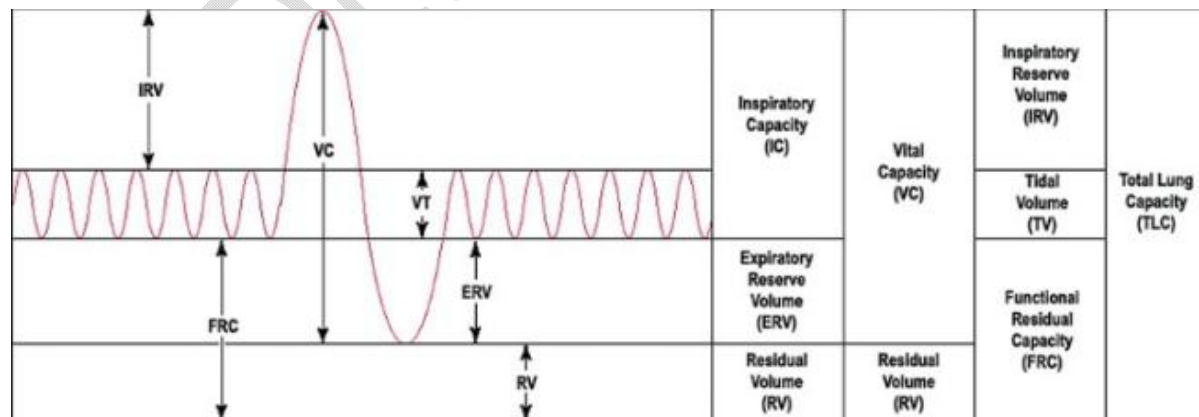
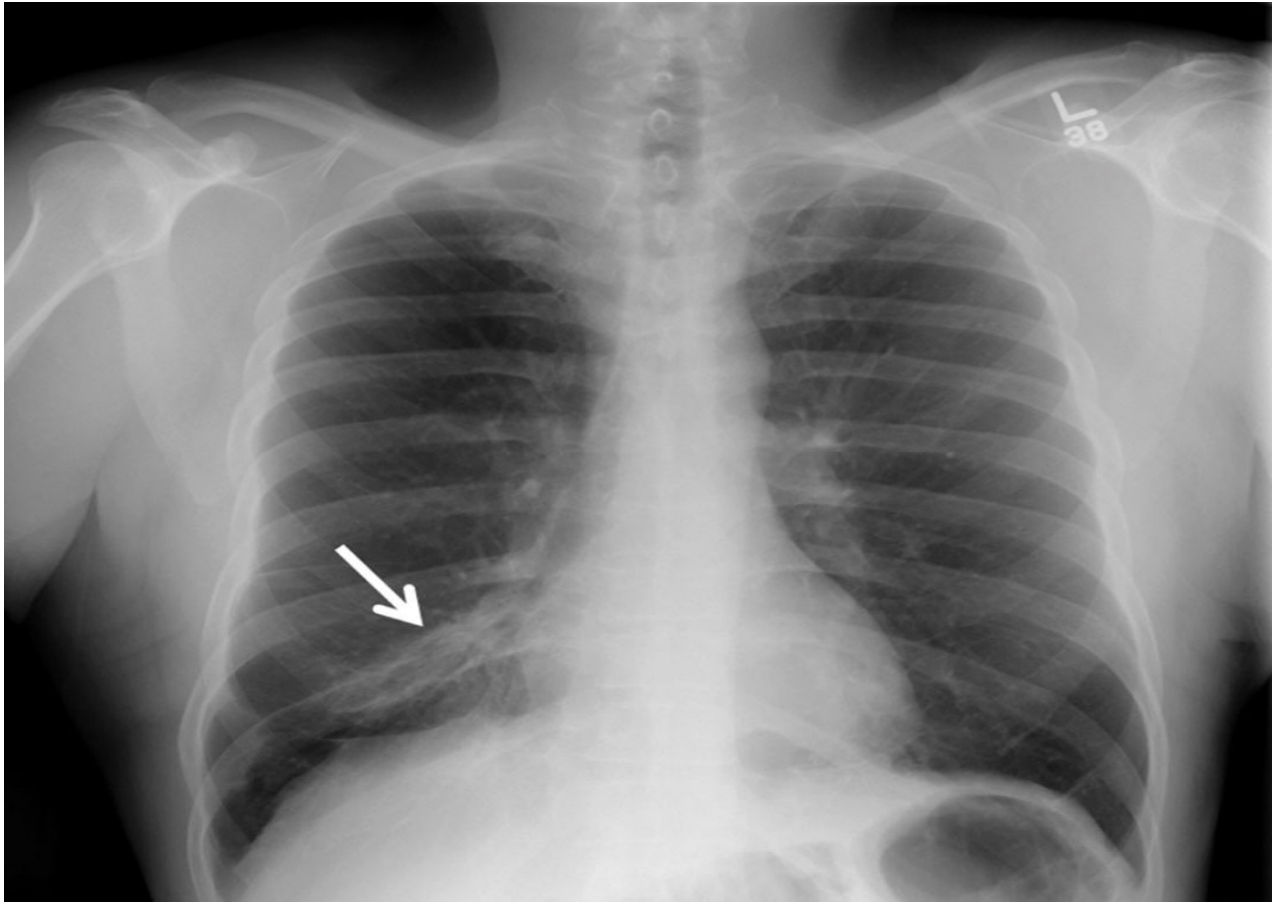


Fig. 3. The graph shows how tidal volume is related to vital capacity and other prime volumes [18].



**Fig. 4. Frontal chest x-ray shows increased lung volumes and ill-defined opacity in the right infrahilar region consistent with middle lobe segmental atelectasis (arrow) [18].**

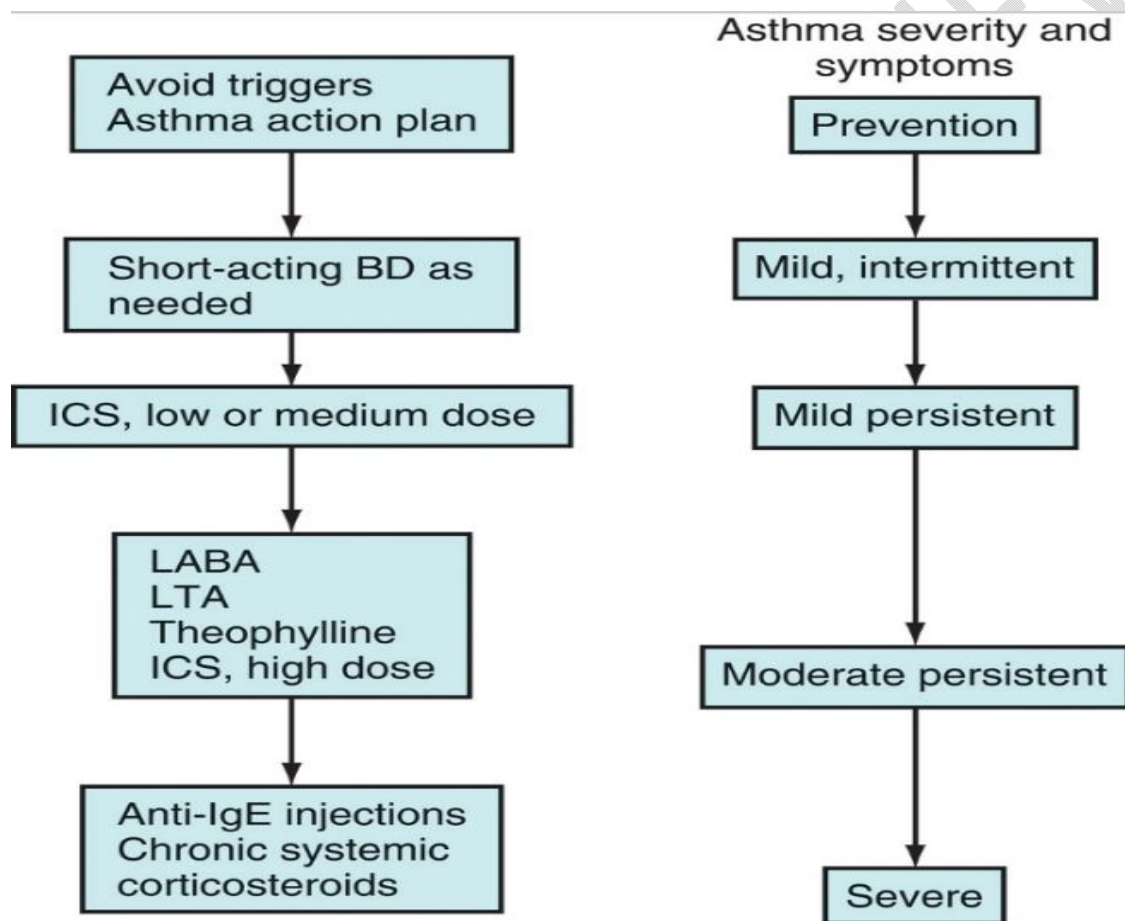


**Fig. 5. Dust mites under the microscope. Environmental control to reduce dust mite exposure can help control asthma for some individuals [19].**

#### Discussion

The patient's complaints are in keeping with asthma [19]. Spirometry will be very important in deciding if there is a proof of obstructive pulmonary disease since this patient has clinical pictures of bronchospasm. However, in asymptomatic patients, spirometry results are always normal in mild asthma. Methacholine challenge test may be used to diagnose asthma as well, but this has to come after a basic spirometry test. Even though chest x-ray and CT can show an unknown development, they are not recommended for people with no evidence of bronchospasm. Bacterial pneumonia is a possible cause of bronchospasm which can be identified using the chest x-ray, however, the patient does not have fever followed by a severe bacteria infection. Arterial blood gas levels will be extremely important if the patient has signs of respiratory distress [20]. NB: You must suspect an imminent respiratory failure if a patient with acute exacerbation of asthma and a respiratory rate greater than normal has normal ABG level [21]. CO<sub>2</sub> is expected to decrease in patients with abnormally rapid breathing. However, a normal arterial blood gas with a normal CO<sub>2</sub> level is suggestive of respiratory muscle fatigue and early respiratory failure. Additionally, all concentrations should be on FEV<sub>1</sub>/FVC ratio as they decrease first in asthma. The forced expiratory volume decreases first as the lung continues to get obstructed. Airway obstruction should be suspected when the ratio of FEV<sub>1</sub>/FVC becomes less than 0.70. This abnormality

should be called an intermittent asthma if she is given an inhaled albuterol months back and she comes back complaining of dyspnea, and wheezing; and if these complaints are caused by mild exercise and cold weather; and if she makes use of the albuterol inhaler more than one time every week; and if she wakes up at night dyspneic and coughing [22]. Patient should continue with the albuterol inhaler as she still responds well to it and has no respiratory difficulty. Inhaled steroids like triamcinolone should be prescribed when symptoms occur more than two days every week. NB: The rule of twos says: all the patients who have more than two asthma exacerbations every week needing rescue drugs or who wake with night symptoms more than two times every month, should be prescribed an antiinflammatory drug like inhaled steroid. Inhaled steroids are more effective than the leukotriene inhibitors; so the antileukotriene should only be administered immediately when the patient stops responding to steroids. They are not used to replace inhaled steroids, they are added to the regimen [23].



**Fig. 6. Stepwise approach for managing asthma. Frequent use of beta-2 agonists following bronchoconstriction, abnormal pulmonary function, and frequent nocturnal awakening, characterize severity of asthma. Drugs are prescribed for patients who use short-acting beta2 agonist more than two times every week to prevent or control symptoms. Normally, treatment is started with inhaled steroids, followed by supplemental controller drugs. Long-**

**term steroids, or anti-igE therapy is recommended for people with recalcitrant asthma. Steroid inhaler, anti-igE, long acting beta2 agonist, and leukotriene receptor antagonist [24].**

## Conclusion

Asthma is a long-standing heterogeneous inflammatory disease of the airways. It is associated with irregular airflow inhibition and bronchial hyperresponsiveness which can reverse spontaneously or follow beta-2 agonist treatment. The manifestations of asthma vary, it includes symptoms (worse at night) like breathing difficulty especially during exhalation, coughing, wheezing, and feeling of heaviness in the chest region. Using the Asthma Symptom Utility Index (ASUI), symptoms can be reliably detected. Asthma care is a lifelong process. While there is no cure, proper treatment tailored to the patient's individual needs and patient adherence to treatment results in a favourable outcome.

## Impact of study

It aids to understand how the abnormality is caused, how it develops, and how it is best treated. In many undeveloped places, asthma is underdiagnosed and its treatment is suboptimal. The study helps to ascertain who is at high risk for developing asthma, certain triggers and ways to avoid having asthma.

## Consent

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

## Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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