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### REVIEW ARTICLE

#### PRACTICAL CONSIDERATIONS FOR THE DIAGNOSIS AND MANAGEMENT OF ASTHMA PATIENTS.

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#### Abstract

Asthma is a chronic inflammatory disease of the airways of the lungs. It is characterized by variable and recurring symptoms, reversible airflow obstruction and bronchospasm. Asthma is caused by a combination of genetic and environmental factors. There is no cure for asthma. Symptoms can be prevented by avoiding triggers such as allergens and irritants and by the use of inhaled corticosteroids. The primary goal of asthma treatment is: preventing chronic symptoms that interfere with daily living, such as coughing or shortness of breath during the night or after exercise. Maintaining lung function near the personal best measurement, preventing repeated asthma attacks. This review is aimed at providing a systemic analysis of the diagnosis and management of asthma, with a particular focus on the most relevant studies about 70 articles published over the last few years. The diagnosis of asthma includes the spirometer test, temperature controlled laminar airflow in severe asthma for exacerbation reduction (THE LASER TRIAL), artificial neural network, fractional exhaled nitric oxide (FeNO), skin prick test, etc. Asthma can be managed by pharmacological as well as non-pharmacological therapies. The non-pharmacological therapy includes acupuncture, acupoint herbal patching, and exercise. Pharmacologically asthma is managed with rescue inhalers to treat symptoms (salbutamol) and controller inhalers that prevent symptoms (steroids). Severe cases may require longer acting inhalers that keep the airways open (salmeterol, tiotropium) as well as inhaled steroids.

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#### Introduction

Asthma is a chronic inflammatory disorder of the airways associated with a variable, widespread, airflow obstruction which is often reversible either spontaneously or with the treatment [1]. Asthma affects over 5.4 million people in the United Kingdom, with nearly 500,000 experiencing severe symptoms and frequent exacerbations that are inadequately controlled with available treatments. Current treatment including oral corticosteroids, 'steroid sparing' immunosuppressants and monoclonal antibody therapies are often of limited efficacy and have potentially serious side effects (steroids, immunosuppressive agents) or are prohibitively expensive (monoclonal antibodies). The

adverse effects of long-term oral steroids include adrenal suppression, decreased bone mineral density, diabetes and increased cardiovascular mortality [2]. Asthma is one of the most common diseases throughout the world and in different parts of the world it has a prevalence of 1.4 to 27.1 percent. Diagnosis of this disease is based on GINA criteria and clinical findings, including coughing, shortness of breath, heaviness, and wheezing [3]. Asthma is characterized by respiratory symptoms combined with variable and reversible airflow obstruction. A diagnosis of asthma is objectively verified by the demonstration of variable airflow obstruction, either by reversibility to bronchodilators or steroids, spontaneous variations assessed by peak expiratory flow rate monitoring or airway hyperresponsiveness assessed by airway challenge tests such as exercise, methacholine or mannitol [4].

#### **Diagnostic Tests:-**

Diagnostic tests are characterized by the sensitivity and specificity. The diagnosis of asthma is usually based on patients clinical history, symptoms, signs, and lung function test. The best strategy for diagnosing asthma remains unclear. Diagnostic tools in asthma are numerous. No single test alone was the optimal test to use but that the diagnostic accuracy increased with multiple testing. Diagnostic test for asthma have well- recognized challenges, which include the practical feasibility of the test, but also to the lack of gold standard for the diagnosis of asthma, which makes validation of diagnostic tests difficult.

#### **Spirometry tests:-**

Children performed spirometry in the standing position without a nose clip with a commercial spirometer (Koko-PDS Dosimeter, nSpire Healthcare Inc., Longmont Co, USA) that includes incentives. Tests were performed according to the official statement on pulmonary function testing in pre-schooling children [5]. These guidelines include the recommended reproducibility and acceptability to rule out abnormal or unacceptable curves. After satisfactory baseline measurements, children received a bronchodilator (2 puffs of 100 mcg Albuterol) administered via a volumetric spacer. Children repeated the spirometry tests 15-20 min after bronchodilator inhalation.

#### **Temperature-controlled laminar airflow in severe asthma for exacerbation reduction(The LASER Trial):-**

The active TLA device significantly reduces nocturnal allergen by filtering ambient air through a high-efficiency particulate air filter, slightly cooling (0.5-0.8 degree) and 'showering' it over the participant during sleep. The figure below shows the temperature controlled laminar airflow device. The reduced temperature allows the filtered air to descend in a laminar stream, displacing allergen-rich air from the breathing zone reducing allergen exposure without creating draft or dehydration. The device is installed next to the participant's bed by a qualified engineer from the company. The device is pre-programmed to turn on and off at times specified by the trial participant but can be turned on and off by manual override if the participant wishes to use the device for an extended period or turn the device off when not in use. The device is easy to use with no identified safety concerns in previous trials. The device is CE marked and licensed for use in the UK for allergic asthma. The device uses the same amount of electricity as a 60W light bulb and has an anticipated life span of 5 years with filter changes required every 6 months. Participants will record whether they have used on daily basis, recorded in a 'LASER' diary. Any additional hours used during the day will also be recorded in the diary [6].

#### **Diagnosis of asthma based on the artificial neural network:-**

The aim of this study is to develop an intelligent system for detecting the presence or absence of asthma in which clinical features in terms of influencing the output are investigated and ordered, and only the effective features are used as the input of neural network. 70% of the data have been trained as the required networks' input to achieve the desired result and reduce errors, and the rest of the data are used to test the system. As a result, the system is able to accurately predict disease based on clinical findings in 100% of the cases [7].

#### **Computed tomography:-**

PFTs: After the patients inhaled a short-acting beta agonist for 15 minutes; PFTs were performed on a computerized spirometer according to the American thoracic society and the European Respiratory Society recommendation [8]. Basic information including age, height, and weight and spirometry data were collected [9].

#### **HRCT Scanning:-**

Chest HRCT was performed at maximal inspiration with the participants in a supine position using a 64-slice spiral CT scanner.

**CT measurements of emphysema:-**

All CT images were automatically analyzed by Airway Inspector Software. The extent of emphysema was measured by the density mask and percentile point method. For the density mask method, emphysema was quantified by percentage of lung voxels with CT attenuation value below -950HU or -910HU on the inspiratory images. In order to study the distributions of emphysema, the lungs were divided into three regions with equal volume: upper, middle and lower. The EI of each region was calculated [10].

**Fractional exhaled nitric oxide:-**

Fractional exhaled nitric oxide (FeNO) is small molecules produced by human secrete cells, which is internationally recognized as a marker of airway inflammation [11]. FeNO is a biomarker of airway inflammation, which may potentially a valuable aid in asthma diagnosis. Fractional exhaled nitric oxide measurement is a simple, rapid, highly reproducible and non-invasive method of airway inflammation assessment. Nitric oxide is an important inflammatory mediator of biological functions in airways [12]; the levels of NO in air exhaled by asthmatic patients are elevated [13]. Thus, NO is a useful marker for evaluating responses to airway inflammation [14]. Fractional exhaled nitric oxide has been shown to correlate with levels of eosinophils in sputum [15] and has been studied as a biomarker tool to help guide clinicians in the management of asthma. FeNO was measured by a Nano Coulomb nitric oxide analyzer according to the American Thoracic Society (ATS) guidelines and expressed as parts per billion (ppb). Patients were tested at resting state.

There are a number of factors that influence FeNO levels, including atopy, height, age, sex, nasal inflammation, respiratory tract infection, consumption of nitrate – containing foods, water, caffeine or alcohol, medication especially inhaled or oral corticosteroids, smoking, exercise and race [16]. Sedentary behavior such as television viewing and video games has also been associated with increased FeNO levels in one study that adjusted for indoor allergen exposure, body mass index and allergic sensitization [17]. Receiver operating characteristic curve was used to determine the best cut-off value of FeNO for asthma diagnosis. FeNO levels asthmatics were significantly higher than non- asthmatics. FeNO was an effective auxiliary diagnosis method for bronchial asthma.

**Aquaporins 1 and 5 levels as a diagnostic marker:-**

Aquaporins constitute a family of proteins highly expressed in the membrane of tissue cells involved in water transportation (e.g. blood vessels, urinary, respiratory and digestive tract) [18]. Among those, AQP1 and AQP5 constitute the principal routes for osmotically driven water transport in the human respiratory tract. AQP1 and AQP5 could be used as a moderate marker for asthma in clinics using receiver operating characteristic (ROC) assay. Water homeostasis plays an important role in maintaining adequate fluid transportation within the lung and is involved in the pathogenesis of asthma [19]. It is found that aquaporins expression showed a tendency towards correlation with asthma. Moreover, the levels of aquaporins could be used as the moderate diagnostic marker for asthma.

**Skin prick test:-**

A small lance with a pinpoint is poked through the liquid into the top layer of skin. This type of skin test is called a skin prick test. Skin prick test was performed according to European standards with a panel of 10 standard allergen extracts [20]. A cut off value of 3mm defined atopy.

**Questionnaire:-**

A questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents. The severity of asthma was classified according to the GINA guidelines as well- controlled, partly controlled or uncontrolled [21].

**Management Of Asthma:-****Non-pharmacological approaches for asthma:-****Acupuncture:-**

Acupuncture has been traditionally used to treat asthma, however, the evidence for the efficacy of this treatment is still lacking. Previous clinical trials of acupuncture in treating asthma were limited by methodological defects therefore high-quality research is required.

As one of the most important complementary and alternative therapies, acupuncture has been used to treat a variety of diseases for more than 2000 years [22]. The National Institutes of Health (NIH) recommended acupuncture as an adjunctive treatment in a comprehensive management programme of addiction, stroke, and asthma [23].

Acupuncture was effective in alleviating asthmatic symptoms and could be used as an adjunct to the conventional medical management of asthma [24]. It also improves lung function and decreased medication dosages [25]. Acupuncture reduces the degree and frequency of exacerbation in patients with asthma [26] and had regulatory effects on mucosal and cellular immunity in patients with allergic asthma [27]. One of the possible limitations in this trial is the unpredictable stress induced by the sham acupuncture which may have a certain effect on asthma.

#### **Acupoint Herbal Patching:-**

Acupoint herbal patching (AHP), which involves local point stimulation with an herbal medicine patch, has long been used to treat patients with asthma in East Asian countries. No serious adverse events were associated with AHP.

Acupoint herbal patching (AHP) involves externally applying a processed herbal medicine preparation patch to acupoints or specific sites on the body [28]. AHP reduces airway inflammation and effectively prevents and treats asthma symptoms, possibly by regulation of serum immunoglobulin E (IgE), eosinophils, nitric oxide, T-lymphocytes and acetylcholine [29].

#### **Acupoint herbal patching versus medicines:-**

When AHP was compared with ICS, bronchodilator and an antihistamine, the FEV1 was significantly higher in the AHP groups than in the medication groups [30]. When the AHP was added to Chinese herbal medications, little additional benefit in pulmonary function was observed.

AHP alone or in combination with standard medications has been shown to significantly improve several measures of pulmonary function and symptoms of asthma, with few adverse effects.

#### **Exercise and sports:-**

Physical activity and sports are important for most people who have asthma. Regular physical activity helps improve heart and lung capacity. It increases the uptake of oxygen and the amount of air that is exhaled when you breathe out. Many affected people think that they should avoid exercise as physical activity is a common asthma trigger. But special asthma treatment can prevent problems due to physical activity. Researchers suggest that sports and exercise can actually reduce asthma symptoms in the long term. Interval training can prevent exercise-induced asthma.

#### **Breathing exercises:-**

There are many breathing exercises and techniques for people with asthma to choose from. They are meant to have a general relaxing effect, as well as help you breathe calm and controlled way during asthma attacks. Relaxation and breathing techniques such as those practiced in yoga may help prevent asthma symptoms and improve your overall well-being. Certain techniques are meant to help people breathe more easily during serious attacks. These include techniques to help you breathe calmly and in a controlled way during an attack, or at the beginning of an attack. Panic and fear can lead to rapid and ineffective breathing (hyperventilation) in such situations.

#### **Avoiding allergy triggers:-**

People with asthma that is caused by an allergy can generally prevent asthma attacks by avoiding allergy triggers, which includes the animal fur, dust mites, and allergy-causing foods. But this is not always possible. People who are allergic to dust mites might be able to prevent allergic reactions by making various changes in their home.

#### **Quit smoking:-**

Smoking can cause a number of medical conditions or make them worse. People with asthma have oversensitive airways, so it is particularly important for them to stop smoking. Having parents who smoke is one of the main risk factors for asthma. If teenagers who have asthma start smoking, their symptoms can become worse.

#### **Dieting:-**

Being very overweight (BMI over 30) can make asthma worse in some people. There is a suggestion that losing a lot of weight can help keep asthma under control. In the positive conclusion, people followed a low-calorie diet under the guidance of experts [31].

**Pharmacological therapy for asthma:-**

Asthma is a heterogeneous syndrome ranging from mild disease with barely noticeable symptoms to very severe disease with constant symptoms that may greatly hinder patient's quality of life. The aim of asthma treatment is control of asthma and the prevention of risk for exacerbations and fixed airflow limitation.

Asthma management must be individualized; not only to the severity of the disease but importantly, to the phenotypic characteristics of the patient and modified according to response to treatment [32].

There are many challenges in the management of asthma in the elderly, including distinct risk factors, decreased cognitive function, lack of energies and poor adherence [33]. Another major challenge would be the lack of clinical evidence on the efficacy of therapeutic agents obtained from elderly patients.

**Corticosteroids:-**

Corticosteroids are used to control persistent airway inflammation in patients with COPD or asthma. The use of corticosteroids in patients with asthma and COPD was associated with lung SqCC [34]. Corticosteroids increase the no. of beta-2-adrenergic receptors and improve receptor responsiveness to beta-2-adrenergic stimulation, reducing BHR and reducing airway edema and exacerbation.

**Inhaled Corticosteroids:-**

ICS is the main drug in the pharmacotherapy for asthma, as chronic airway inflammation is a key feature of the disease [35]. ICS improves symptom control, quality of life, lung function, exacerbation risk and asthma-related mortality [36]. As ICS largely targets eosinophilic inflammation the effects could vary with inflammatory profiles of asthma patients. To maximize the efficacy of ICS therapy while minimizing the dose-dependent risk of adverse effects, several steroids – paring approaches have been made but mostly been unsuccessful, except for concomitant long-acting beta-2-agonist. Inhaled corticosteroids have reduced local and systemic inflammation among patients with asthma [37]. ICS drugs beclomethasone, budesonide; fluticasone and ciclesonide were related in the major drugs, whether dispensed alone or in combination with an inhaled beta-2-agonist. ICS therapy form basis for treatment of asthma or COPD, improving disease control and reducing exacerbations [38].

**Mometasone furoate nasal spray:-**

Mometasone furoate nasal spray is used in the treatment of asthma, rhinitis and rhinosinusitis, inflammatory skin disorders and penile phimosis [39]. MF drug powder inhaler has been demonstrated to have an excellent safety and efficacy profile and during post-marketing surveillance and in clinical trials no significant adverse effects have been reported. Its simple use seems to improve asthma management by addressing issues that generally inhibit proper adherence to therapy [40]. These considerations for the usage of MF in asthma could be extended to MF administered via the intranasal route. As regards the safety, MF has demonstrated an excellent safety profile pregnant women can safely use it, no systemic affects growth velocity and adrenal suppressants. MF has been demonstrated to be effective in the treatment of the inflammatory disease of the nose and paranasal sinuses. ICS is the cornerstone of pharmacological treatment of asthma, which probably holds true also in the elderly.

**Systemic corticosteroids:-**

Systemic corticosteroids are more potent than ICS but also have higher risks of side effects. Chronic use of systemic corticosteroids is associated with many side effects including, osteoporosis, obesity, coronary artery disease, stroke etc. In a dose-dependent way, this could be more problematic in severe/elderly asthma patients [41].

**Prednisolone [PDS]:-**

Prednisolone is a synthetic glucocorticoid that is used as the anti-inflammatory or immunosuppressive agent. It is indicated in conditions where corticosteroid therapy is likely to be beneficial, including allergic disorders, asthma, leukemia, thrombocytopenic purpura, ulcerative colitis [42]. Prednisolone oral dispensing tablets were developed to improve the patient compliance in pediatrics who suffered from asthma.

**Inhaled beta-2-Adrenergic:-**

Beta-2-adrenergic agonists are listed as banned substances because they can be used for athletic performance enhancement [43]. However, BA is listed as one of medication to prevent and treat the symptom of exercise-induced bronchospasm (EIB) among athletes, with or without a known diagnosis of asthma. Accordingly, athletes are

sanctioned for BA use except when taking salbutamol, salmeterol, and formoterol for medical reasons by inhalation at a maximum dose and the urine concentrations must not exceed a threshold value for salbutamol and formoterol. Inhalation treatment with adrenergic agonist (previously epinephrine) for asthmatic bronchoconstriction has long been applied in clinical practice. Beta-2-adrenergic receptors have been later found to be more specific in dilatation of bronchial smooth muscle cells and thus its specific agonists have been developed successfully. Now several types of inhaled beta- 2-adrenergic agonists are available in clinical practice, short-acting beta-2-agonist like salbutamol, long-acting beta-2-agonists like salmeterol or formoterol and ultra LABA like indacaterol.

#### **Long-acting beta agonist:-**

LABA as monotherapy has been related to risks of asthma-related morbidity and mortality and thus is not recommended alone. In a recent Cochrane group meta-analysis of random controlled trials comparing regular ICS+LABA vs. Same- dose ICS groups, no significant differences were formed in fatal or non-fatal serious adverse events between two groups [44].

The subjects who received fluticasone –salmeterol combinations had a significantly reduced risk of inpatient hospitalization (32%) and emergency department or inpatient hospitalization (22%) than those who received ICS [45].

#### **Short-acting beta agonists:-**

SABA is only indicated for a rapid relief of bronchoconstriction (onset 5to10 minutes) but never recommended as a daily regular medication now. Regular use of SABA as monotherapy, particularly formoterol was previously formed to have significant relationships with poor asthma control compared to as needed use of SABA. In addition, regular use of formoterol was strongly related to asthma-related mortality in a dose-dependent manner [46].

#### **Salbutamol:-**

Salbutamol is one of the most popular SABA used to relieve asthma symptoms. The medication can prevent asthma symptoms and should be taken 10 to 15 minutes before exercise. It will prevent symptoms for up to 4hrs. Based on the current WADA guidelines, the SABA salbutamol can be prescribed up to 1600 micro gm. per 24 hr. Historically salbutamol was the first bronchodilator listed in the international anti-doping list according to a urinary threshold for sanction. Patients reported they used SABA some days before exercise when they observed a 'short breath' compared to other days. No one had ever had a severe asthma attack.

Salbutamol abuse detection by athletes is based on the urinary upper threshold defined by the World Anti-doping Agency [WADA]. The maximum urine concentrations value peaked after the cycling effort. That is twice lower than the actual WADA threshold to sanction salbutamol abuse. In the case of an asthma attack or in the presence of recurred symptoms the dose of inhaled salbutamol could be increased but we argue that athletes should also be excluded from risky situations for EIB like hyperventilation is common during competition [47].

#### **Anti-Cholinergic:-**

Airway hyper responsiveness to cholinergic stimulation is a hallmark of asthma and thus to blockade of muscarinic receptors should be a potential therapeutic option. However, it has been just recently that this drug started to be considered as clinically important in asthma. M3 receptor has been identified to have more important roles in the cholinergic bronchoconstriction pathway than other subtypes and is considered to be the main target for bronchodilator in asthmatic airways [48]. The potential adverse effects of anticholinergic should be paid attention in the elderly, such as dry mouth, blurred vision, constipation or urinary retention.

#### **Long-acting anticholinergic:-**

Tiotropium bromide is one of the well-known long-acting anti-cholinergic with M3 kinetic selectivity. Among adult patients with asthma inadequately controlled on low dose ICS, Tiotropium 18mcg add-on was superior to double ICS dose and non-inferior to salmeterol 50mcg bid add-on in improving morning peak expiratory flow [49]. Long-acting anticholinergic will be an appropriate alternative to LABA in the elderly. Tiotropium did not increase the risk of subsequent cardiovascular events, compared to placebo [50].

**Short-acting anticholinergic:-**

Short-acting anticholinergic, including ipratropium bromide, failed to show significant efficacy. Its lack of efficacy is supposed to be due to their lack of selectivity in antagonism, as simultaneous stimulation of muscarinic subtypes could result in the decrease in bronchodilator effects [51].

Short-acting anticholinergic agents have been used in asthma for decades; however, their exact role in asthma has not been well established [52]. Studies comparing short-acting anticholinergic and SABAs have shown that SABAs provide greater bronchodilator than short-acting anticholinergic agents alone in stable asthma [53]. However, individual studies have demonstrated that specific asthma populations mainly the older patient [54] and those whose asthma is related to psychogenic factors [55], cigarette smoke or beta-blocking drugs might benefit from anticholinergic therapy.

A Cochrane review of combined inhaled SAMAs and SABAs showed a lower risk of hospital admission and a greater improvement in lung function [56]. Thus the use of short-acting anticholinergic bronchodilator in a fixed - dose combination with a SABA has a greater effect on lung function in moderate to severe asthma than SABA alone, and should, therefore, provide better symptomatic relief.

**Anti-leukotrienes:-**

Cysteinyl leukotrienes are potent bronchoconstrictors and chemoattractant for eosinophils and thus have been important therapeutic targets in asthma patients. Currently, two types of drugs are available in clinical practice - leukotriene's receptor antagonists (LTRA) and 5-lipoxygenase inhibitors [5-LO]. LTRAs (monteleukast, zafirlukast) mostly antagonize CysLT1 receptor only, but 5-LO inhibitor can inhibit the productions of all the leukotrienes including CysLt and LTB4 [57].

As a monotherapy, monteleukast offers a rapid bronchodilator effective in asthma, patients regardless of their concurrent ICS treatment status [58].

Conclusions from clinical studies on efficacy are still controversial in the elderly patients the effects might decrease with aging. In a 4-week open-label trial involving 3700 asthma patients, the addition of zafirlukast provided a clinical improvement in asthma patients as overall, but the clinical effect was less evident in the elderly compared to younger patients [59]. Also in 24 months of long-term clinical observation study, LTRA add-on to ICS improved clinical outcomes in elderly patients with severe asthma [60]. As LTRA may potentially be a good option in the real world practice of elderly asthma patient.

**Theophylline:-**

Theophylline has been widely used in the treatment of asthma since 1922 as it less expensive and oral forms are available [61]. Theophylline is a weak non-selective inhibitor of phosphodiesterase isoenzymes. As a bronchodilator, it is less effective than beta-2-agonist [62]. Also as an anti-inflammatory drug, it is less effective than ICS. The relatively high dose of theophylline is required to exert bronchodilator effects.

In a pilot study of 68 smoking patients with mild to moderate asthma, the addition of low dose and theophylline sustained release form to 200mcg per day beclomethasone further improved in peak expiratory flow and asthma control [63]. In subsets of steroid-resistant asthma patients such as smoking asthma or severe asthma attack, reduced histone deacetylase 2 activities have been related to the resistance mechanism. Sustained release form of theophylline is easier to control serum level and considered to be safer.

**Anti-IgE monoclonal antibody:-**

IgE is a key medication in several allergic reactions type1 hypersensitivity mechanism. Thus the invention of omalizumab, a recombinant humanized monoclonal IgG antibody [64], has provided a breakthrough in clinical practice for IgE- mediated disease including allergic asthma. Adult patients with moderate or severe allergic asthma omalizumab add-on therapy significantly improved asthma outcomes such as exacerbation and hospitalization rates, compared to placebo [65].

In the analysis of multicenter registry disturbance of severe asthma patients in Spain, omalizumab was similarly effective in between non-atopic and atopic patients [66].

**Issues Surrounding Pharmacological Treatment:-****Choosing inhaler device:-**

The main route of drug administration for asthma including the corticosteroids, beta-2- agonists or anticholinergic is the inhalation. Inhaled therapy is the cornerstone of asthma management in that it optimizes the delivery of the medication to the site of action. The effectiveness of inhaled therapy is affected by the correct choice of device and proper inhalation technique. In reality, the 'ideal inhaler' does not exist and not all nitrates are the same.

**Adherence:-**

The clinical significance of adherence also applies to elderly asthma patients but it may be a complex issue [67]. Asthma is a complex disease and requires education of the patient and his or her family if it is to be managed successfully.

**Polypharmacy and drug interactions:-**

Comorbidity is a major consideration in the pharmacological management of asthma in the older patients, as multiple comorbidities are frequent [68] and it leads to polypharmacy and the polypharmacy could, in turn, lead to more drug interaction issues.

**Management During Pregnancy:-**

Asthma is the most common chronic disease which will affect the pregnant women. Asthma exacerbations are common in the pregnant women and occur up to 45% and it is associated with an increased risk of adverse perinatal outcomes [69]. These require medical interventions with the 20-30% of women with asthma who continue to smoke during pregnancy. Treatment adjustment using a marker of airway inflammation reduces the exacerbations rate in the pregnancy.

One strategy that had become a success in reducing the asthma exacerbations in the pregnancy is the treatment adjustment using a marker of eosinophilic lung inflammation. The exhaled nitric oxide fraction guidelines recommend the use of short-acting beta agonist (SABA) as relieves medication and use of inhaled corticosteroids (ICS) for women having persistent asthma [70]. ICS were perceived to be the safest and preferred to prevent medications for the first trimester. The main drug used in ICS in the pregnant women is the budesonide. The continued use of ICS will provide effective content in asthma during pregnancy. Other than ICS the leukotriene's receptor antagonists (LTRA) can also be safe and used in the first trimester. Guidelines recommend managing asthma actively during the pregnancy, with a regular 4-weekly review, provision of the written action plan; use of preventer medication is indicated for the adults and management of comorbid conditions.

**Interactive digital interventions to promote self-management in adults with asthma:-**

Educations to the patient and proactive self-management have been shown to improve the clinical outcomes in people with asthma. One potential method for improving the self-management is through the use of interactive digital intervention (IDIs), which offer the possibility of enabling patients to self-manage long-term conditions such as asthma and hence improve outcomes [71].

**Conclusion:-**

This study reveals the assessment of diagnosis and management of asthma. Since the 21st century, diagnostic tests such as lung function (spirometry), allergy test etc. are undertaken for patients. It is found to improve the quality of care and outcomes for people who have asthma by providing health care providers with the tools and information. Non-pharmacological treatment such as avoidance of asthma triggers, dieting and exercise are adopted to optimize the management of an asthmatic patient. Pharmacological management includes the use of inhaled corticosteroids. It also suggests the use of short-acting beta-2-agonists per year is associated with relatively less risk of hospitalization for patients using ICS. Pharmacological therapies reduce the frequency and severity of asthma exacerbations and reverse airflow obstruction. Thus it is inferred that diagnosis and management of asthma lead to the improvement in the quality of life, minimization of symptoms and the risk of adverse outcomes due to asthma flare-ups.

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