Pedia Companion

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Evaluation of errors in metered dose inhaler usage among the pediatric asthma patients

The use of smartphone recordings is a convenient way to evaluate errors in metered dose inhalers usage

Introduction

Asthma is a chronic airway inflammation syndrome characterized by airway hyperresponsiveness that causes recurrent episodes of acute bronchoconstriction, which includes wheezing, breathlessness, chest tightness, and coughing, particularly at night or in early morning.[1] About 13% of cases are due to environmental allergens like dust, pollen, air pollutants, and insects in India. Inhaler devices are crucial for the treatment of asthma in children. Metered dosage inhalers (MDIs) are frequently recommended due to their low cost, portability, affordability, quick-acting, and lower inspiratory force needed for dispensing medicine. There was a significant lack of studies conducted in pediatric populations regarding the use of MDIs.[2] This study aimed to provide physicians with an easy method to objectively verify Medical Device Inhaler (MDI) technique using readily available smartphones, without requiring additional devices. Additionally, this study evaluated the incidence of inhaler technique errors and their effect on asthma management.

Methods

This study included 32 asthmatic children between the ages of 5 and 18 receiving therapy through MDIs. A smartphone audio recording of the patients using their MDI was made at least 6 months following the initial training. The participants instructed to demonstrate how to use their inhalers both with and without a spacer. A recording was made approximately 5 centimeters away from the inhaler mouthpiece. Apart from documenting their MDI usage, the Forced Oscillation Technique (FOT) based system was utilized to record their Pulmonary Function Tests. All participant received three surveys to assess patient characteristics, asthma control, and device history. Using smartphone recordings of inhaler audio signals, the patient's technique was evaluated. Before and after corticosteroid administration forced oscillation technique (FOT) was performed during tidal breathing conditions.

Results

Only six subjects (19%) out of 31, performed all the essential steps for proper use of their MDI. The most common errors were rapid shallow breathing, failing to hold their breath for ten seconds after inhalation following actuation, and frequent actuation. Poor inhaler technique had a significant correlation with poorly controlled asthma symptoms. According to statistical analysis, the most clinically significant predictor of incorrect patient technique was the breath count per actuation. Patients were further categorized based on asthma control score, patients with poor symptom control (<20) exhibiting rapid breathing taking greater than 4 breaths per single actuation were grouped together. Patients with well controlled asthma (ACT Score >22),

each performing the advised 1–2 breaths per actuation were allocated in second group. Statistical analysis was performed which showed poor inhalation technique does play a significant role in determining health-related outcomes in asthmatic children, leading to disruption of normal routines (Figure 1). Seven patients who used MDIs good or almost correctly had ACT scores >19, which indicates partially to well controlled asthma.

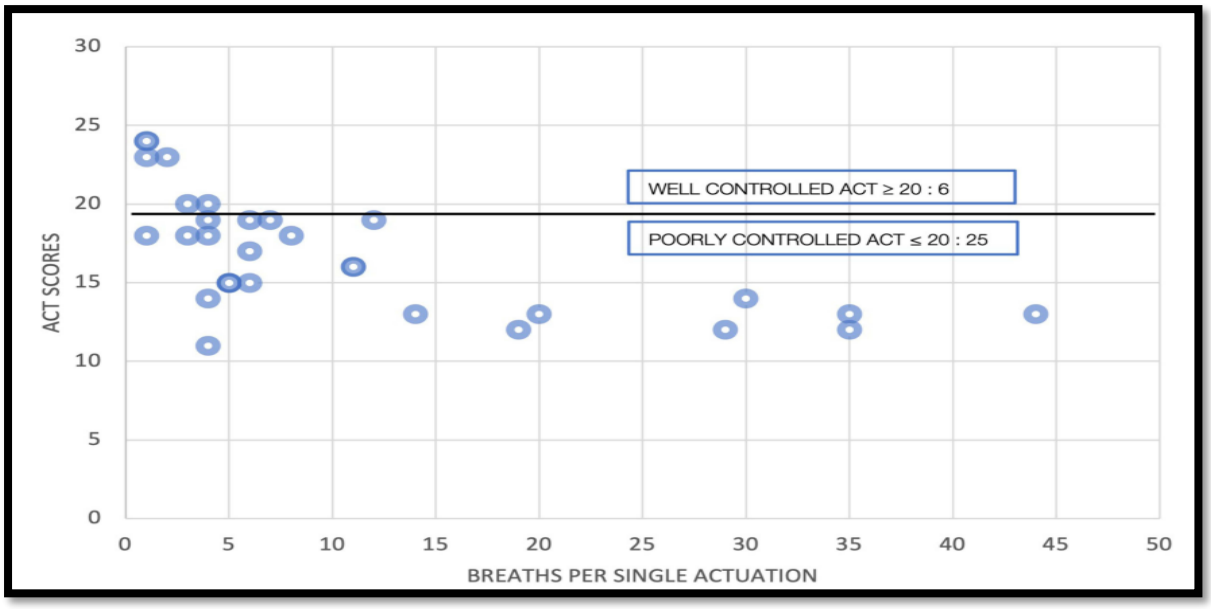

Figure 1. Effect of MDI usage on asthma management

Discussion

The majority of children in the study were unable to appropriately use their inhalers. Additionally, the study's findings demonstrated that ineffective inhaler technique has a clinically significant impact on patients' health, demonstrated by poor asthma control scores. Study demonstrated for the first time that breathing technique errors may be assessed using a simple phone recording of audio while using an inhaler. A simple system that keep track of patients' symptoms and gives them feedback can be a crucial tool for improving asthma treatment and results.[2] Price D et al. showed that frequent training interventions involving multimedia-delivered training and physician supervised checks helped patients in reducing errors.[3]

Conclusion

This study has shown that even among individuals who have previously received instruction through physician demonstration, errors in MDI technique were common. The recommended course of treatment for individuals with asthma was inhaled medications. However, the patient's capacity to use the inhalation device appropriately was a barrier to the effectiveness of these therapies.

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Assessment of Ventilator-induced diaphragmatic dysfunction (VIDD) and its associations in new-borns

Introduction

Study highlights the importance of diaphragm ultrasound to assess diaphragm atrophy and predict extubation failure in clinical practice.

The thoracic diaphragm is the main muscle for respiration and it contributes to most inspiratory tidal volume. Diaphragmatic function failure has been associated with respiratory failure and higher mortality with neuromuscular disease.[1] Invasive mechanical ventilation (IMV) is still commonly administered to preterm infants which leads to a rapid development of diaphragmatic weakness due to the onset of muscle atrophy and contractile dysfunction. This condition was described as ventilator-induced diaphragmatic dysfunction (VIDD) which has been increasingly studied. Diaphragm atrophy (DA), is one of the signs of VIDD. The emergence of VIDD and DA has been associated to adverse effects in children and adults receiving IMV, including extubation failure, higher mortality, and extended hospital stays.[2] Hence, this study aimed to describe the diaphragm thickness during IMV as well as the frequency and associations of DA with a focus on the relationship between DA and extubation failure.

Methods

This was a single-center prospective study which included preterm infants born <37 weeks of gestation who required IMV for at least 48 h during their NICU admission. Study calculated diaphragm thickness at end-inspiration (DTI) and end-expiration (DTE). Preterm newborns on invasive mechanical ventilation measurements were recorded daily for ≥2 days. Clinical characteristics and extubation failure were recorded. The variables that associated with VIDD were described using mixed models, logistic regression, and univariate analysis.

Results

During the study period, 17 patients were included and 22 IMV cycles were evaluated.

DTE was 0.118 cm on the first and 0.104 cm on the last IMV day. For the first two days of IMV, the mean daily percentage change in DTE was −2.5 %. A non-significant decline was seen by DTE on IMV with time, as indicated by a regression coefficient of -0.004. DA was evident in 11/22 (50%) of the IMV cycles from 10/17 patients (58.8%) at any point during the IMV cycle. Whereas DA was detected in 8/22 (36%) of the IMV cycles between the first and last day of the cycle. Early in the IMV course, DA occurred. During first IMV day mean airway pressure (MAP) and lung ultrasound score (LUS) were significantly higher in patients who developed DA. In seven cycles, DA was found to evident on the second IMV day, in other three cycles during the third IMV day, in another cycle during the fifth IMV day. With respect to the incidence of DA in the newborn groups with and without extubation failure, this study has 68.6% power to identify differences with $p \leq 0.05$. Extubation failure was evident within 7 days after 6/22 (27.3%) IMV cycles. Patients with extubation failure had a higher frequency of DA (at any point during the IMV cycle) than patients who had successful extubation within 7 days (83.3 vs. 33.3%).

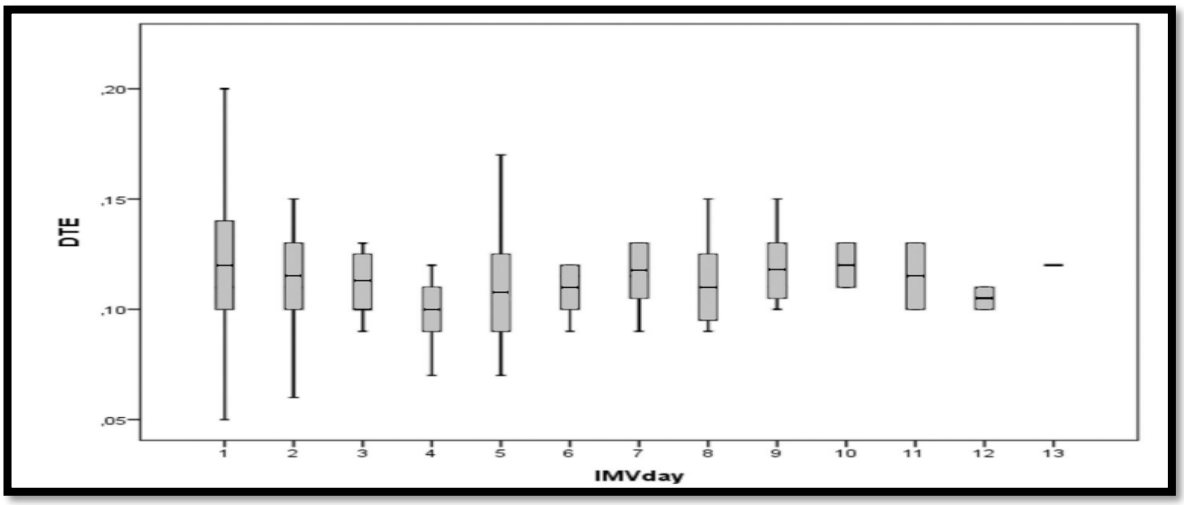

Figure 1. Results of effect of time on invasive mechanical ventilation on Diaphragm thickness at end-expiration (DTE)

Discussion

This study's main findings were that DA was linked to an increased risk of extubation failure and that it frequently occurred in infants receiving IMV.[2] In a recent study conducted on 20 extremely preterm infants, 90% of them were found to have VIDD.[3] This study result showed a significant association between DA and higher LUS and MAP on the first day of IMV which was similar with the another study result showing higher LUS was associated with extubation failure confirms the results of a recent study in preterm infants.[4]

Conclusion

Development of DA was observed in 50% of the IMV cycles and was associated with extubation failure. Higher MAP and LUS were associated with DA during the first IMV cycle.

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Assessment of the exact diagnostic and treatment algorithm with emphasis on minimal invasive intervention in the management of osteochondral fractures among Pediatric patients

Introduction

Arthroscopy treatment optimize the osteochondral fractures management with early rehabilitation as well as extremely low probability of complications

Acute patellar dislocations (APDs) in pediatric patients is a common cause of knee pain. Between the ages of 10 and 17, 29 out of 100,000 children will experience at least one patellar dislocation, and 35 percent of these individuals will experience recurring patellar dislocations.[1] Children's lower limps can be injured by acute patella dislocation and ankle sprains, which can lead to free cartilage fragments in the injured joint. The serious consequences of not treating osteochondral fractures (OCFs) indicate that it's important to diagnose them as soon as possible. The most frequent outcomes of mistreatment are significant joint functional impairment that significantly affects their everyday activities and, especially, early-onset arthritis caused by increasing chondral destruction.[2] Hence, this study aimed to address diagnostic and therapeutic challenges in managing osteochondral fractures (OCFs) resulting from acute patella dislocation and ankle sprains in pediatric population.

Methods

This study was a retrospective observational cohort analysis which included a total of 15 patients with osteochondral fractures. Descriptive statistics method was used to summarize baseline characteristics. Univariable and multivariable logistic regression was used to evaluate the interactions between free fragments and other characteristics as well as prognostic factors for recovery throughout a wide range of time periods.

Results

All 12 patients experiencing knee joint pain were prescribed an MRI, which revealed the osteochondral lesions. The treatment strategy stated that 7 (58.3%) had a free fragment in their joint and required small open reduction following debridement and fixation, whereas 5 (41.7%) had arthroscopic fixation in situ with bio-absorbable pins. Talus OCFs underwent small open reduction after debridement and fixation as preoperative MRI and plain radiography both showed the presence of a free fragment. All patients with knee OCF had postoperative X-ray, a follow-up X-ray, and a new MRI at 3 months, showing the progressive restoration of osteochondral continuity in both cases of arthroscopy and mini open procedure. For 4/15 (26.7%) at 3 months, 11/15 (73%) at 6 months, 14/15 (93%) at 9 months, and all 15/15 at 12 months, full-motion rehabilitation was achieved. 3/5 patients (60%) who had arthroscopy had complete motion rehabilitation at 3 months and all of them at six months after surgery. After surgery, all talus OCF patients were entirely recovered after 9 months. Age and the decision for arthroscopy were the risk factor for OCF.

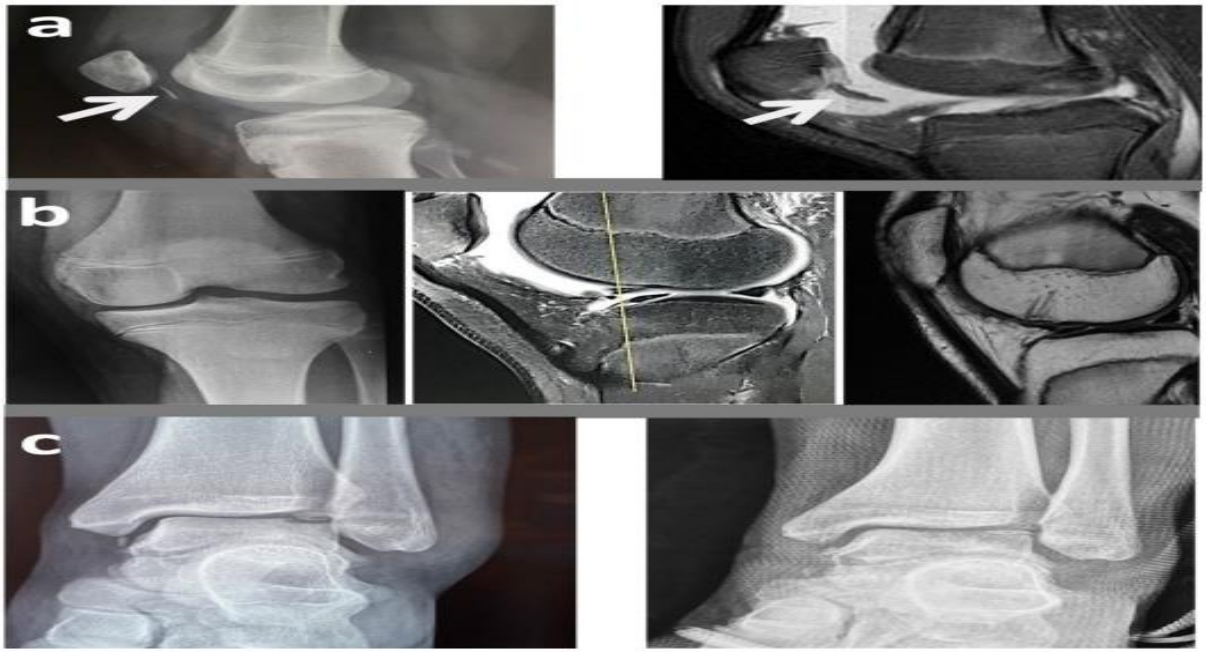

Figure 1. (a) free fragment in the knee treated by mini open fixation (b) knee osteochondral lesion treated by arthroscopic fixation (c) talus-free fragment treated by mini open fixation

Discussion

This study highlighted the importance of MRI as a diagnostic tool instead of plain x-ray. Pediatric patients treated via arthroscopy, regained regular activities and full mobility within a year. Early identification and the start of minimally invasive therapy were advised considering of the documented effects of admission delay on rehabilitation at 6 months postoperatively and age as a risk factor for a free fragment. This study results stated that Arthroscopy helps to optimize the OCFs management and early rehabilitation and has a less complications.[2] A study while comparing between conservative management and surgery stated that surgery was the better option in case of osteochondral fractures.[3] Talus OCFs were less prevalent than patella OCFs, although arthroscopic fixation has been shown to be an effective therapy for these lesions as well.[4]

Conclusion

Osteochondral fractures should be thoroughly investigated in cases of acute patella lateral dislocation or ankle sprains and imaging should be performed as soon as possible after an injury. Internal fixation either arthroscopically or with mini open technique can restore joint's functionality within a year.

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Case report on autoimmune polyglandular syndrome type 2 in the form of carpenter syndrome

Introduction

Autoimmune polyglandular syndrome type 2 (APS-2) is the coexistence of Addison disease and at least one of the disorders like autoimmune thyroid diseases and/or type 1 diabetes mellitus.

Autoimmune polyglandular syndromes are a rare class of polyendocrine disorders that included multiple glandular deficiencies associated with other autoimmune diseases. Autoimmune polyendocrine syndrome type 2 (APS II) is defined by presence of Addison's disease (AD) linked to autoimmune thyroid disease and/or type 1 diabetic mellitus (DM).[1] The frequency of APS-2 was about 1.4–4.5 cases per 100,000 persons. Carpenter syndrome is a triad of AD, AITD, and T1DM. The main diagnostic difficulty is that clinical manifestation can differ but autoimmune diseases have become increasingly common.[2] This case described a patient diagnosed with adrenal insufficiency, autoimmune thyroiditis, and type 1 diabetes.

Case presentation

A 13.5 years old female patient was admitted to the hospital with the complaints of suspected adrenal insufficiency and hypothyroidism. Patient had recurrent abdominal pain and emesis for about 3 years, occurring about every 6 months. Patients thyroid stimulating hormone (TSH) test showed a slightly increased result (6.5 uIU/ml). Patient had a family history where her mother suffered from autoimmune thyroiditis (diagnosed after pregnancy with the presented patient), her father had vitiligo, and her older brother had T1DM and celiac disease. On physical examination, it was found that patient had hyperpigmentation of her skin, nipples, furrows in the hands, and mucosa in the oral cavity (Figure 1). Grade 1 goitre was seen in the patient. Patient had ratings of thelarche 3, pubarche 3, and axillarche 3 on the Tanner scale. Primary adrenal insufficiency has been identified as a result of low cortisol concentrations following 250 µg of adrenocorticotropic hormone (ACTH) stimulation, significantly raised ACTH, hyponatremia, and hyperkalemia. Furthermore, autoimmune thyroiditis was diagnosed by the presence of significantly high anti-thyroglobulin antibodies (TgAb) and anti-thyroid peroxidase antibodies (TPOAb), together with subclinical hypothyroidism (elevated TSH concentration and normal free tetra iodothyronine concentration) and typical ultrasound picture. The autoimmune aetiology of adrenal cortical insufficiency was confirmed by the positive antibodies against the adrenal cortex. Considering the cortisol insufficiency, the fasting glucose concentration was 101 mg/dl, and the glycated haemoglobin (HbA1c) was 5.7%. The presence of anti-glutamic acid decarboxylase antibodies (GADAb) suggested an autoimmune disease and recommended monitoring for diabetes mellitus. Patient was

prescribed to take hydrocortisone (20 mg daily), fludrocortisone acetate (0.075 mg daily), and levothyroxine sodium (37.5 mg/dl). A month later patient presented with complaints of polydipsia and polyuria for about 3 weeks. Prior to admission the glucose level was 600 mg/dl and HbA1C was 7.1%. Test report showed glucosuria and a lack of ketone bodies in the urine. The patient was diagnosed with T1DM for which insulin therapy was prescribed. At the same time, primary adrenal insufficiency, autoimmune thyroiditis, and T1DM constituted to the diagnosis of APS-2.

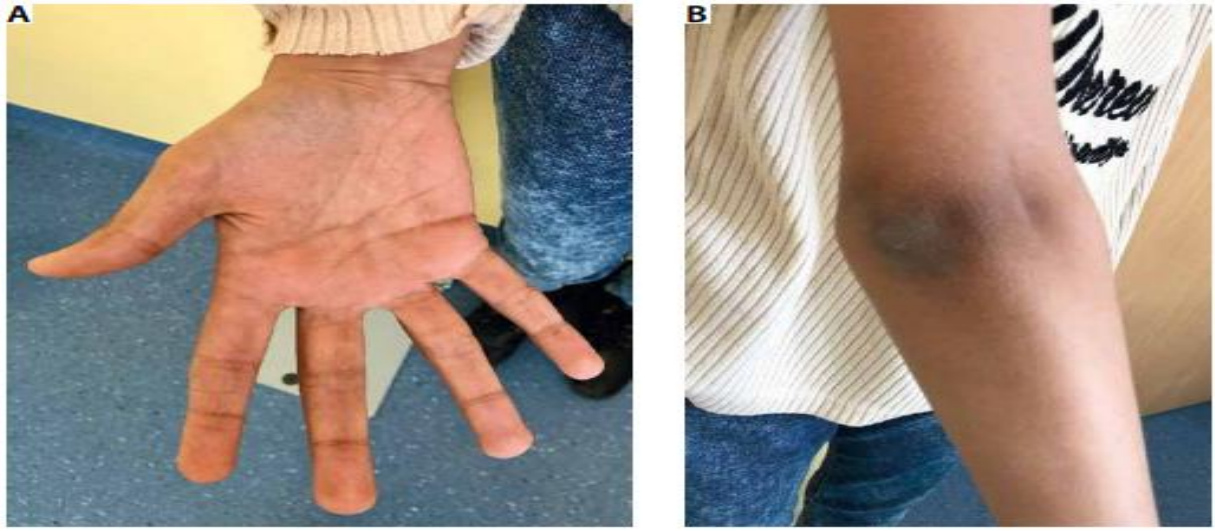

Figure 1. (a) Hyperpigmentation of the furrows in the hands (b) and the skin on the elbow

Discussion

In this case, patient presented this rare combination of conditions such as adrenal insufficiency including emesis, fatigue, hyperpigmentation, and abdominal pain. Also, hyponatremia and hyperkalaemia were the laboratory signs of this condition. Due to this conditions patient was initiated with adrenocortical and thyroid hormone replacement, which later the patient developed diabetes mellitus.[2] A similar report was described which presented a case of a 15-year-old boy with well-controlled T1DM, who had sudden, frequent episodes of hypoglycaemia, and finally was diagnosed with AD, which led to APS-2 diagnosis.[3]

Conclusion

Early manifestation should be considered in case of APS-2 diagnosis and patient should be under long term observation as it was possible to develop clinical symptoms of another autoimmune disease after the initial diagnosis and introduction of adequate primary treatment.

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