2019 Year in Review: Asthma

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Asthma is an obstructive airway disease affecting children and adults throughout the world. It is a heterogeneous disease with a variety of causes and treatments. Research in the diagnosis, treatment, and management of asthma is ongoing, and there were > 8,000 publications on asthma in 2019. This paper reviews several research articles about asthma from 2019 that are most relevant for practicing respiratory therapists caring for patients with asthma. *Key words: asthma; asthma education; MDI; respiratory therapy*. [Respir Care 2020;65(7):1024–1029. © 2020 Daedalus Enterprises]

Introduction

Asthma is an obstructive airway disease that is the most common cause of acute hospital admission in children and represents an important source of morbidity in adults.[1] Asthma frequently requires care provided by respiratory therapists (RTs), who provide treatment during asthma exacerbations, oversee the management and education of patients with stable asthma to prevent exacerbations, and perform pulmonary function testing to aid in the evaluation and diagnosis of patients with asthma. Best practice in the care of patients with asthma is constantly evolving due to ongoing research. More than 8,000 peer-reviewed, scientific publications about asthma were published between January and October of 2019. This review focuses on 9 selected publications from 2019 that are particularly relevant to practicing RTs caring for patients with asthma.

Methods

A PubMed search was conducted to determine the number of papers published between January and October of 2019 involving asthma. Searches for the key words "asthma," "wheezing," and "wheeze" resulted in > 8,000 publications. The search was further refined by selecting only those studies that contained one of the following key terms: "respiratory therapy," "protocols," "mechanical ventilation," "exacerbation," "bronchodilation," or "respiratory care." Nine manuscripts were identified from the search and were categorized as asthma diagnosis (1), asthma education

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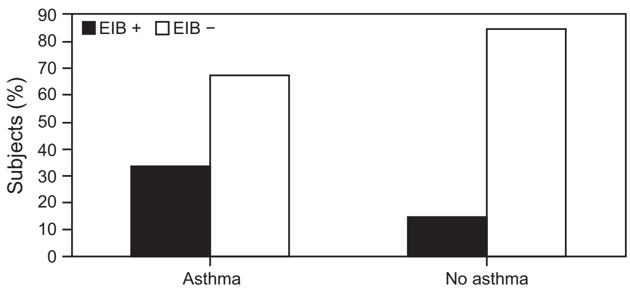

Fig. 1. Percentage of EIB-positive and EIB-negative subjects with and without asthma. More than 60% of subjects in both groups did not experience EIB during testing. EIB = exercise-induced bronchospasm. From Reference 2.

(1), pressurized metered-dose inhaler (pMDI) instruction (2), RT-driven asthma protocols/management (2), and asthma treatment (3). These manuscripts and their findings are therefore discussed below.

Manuscript Reviews

Diagnostics

Due to its low cost and risk, many centers rely upon simple exercise-induced bronchoconstriction (EIB) challenge testing to determine the cause of exercise-induced dyspnea. Although the specific methodology for this testing can vary between centers, it generally involves exercise on a bicycle or treadmill while assessing spirometry results in an effort to identify bronchospasm. Bhatia and Schwendeman[2] conducted a retrospective study to evaluate the performance of using a simple EIB challenge test in a cohort of pediatric subjects. The simple EIB test involved incremental increases in exercise effort on a treadmill and spirometry recordings taken at specific time intervals. A reduction of $\geq$ 10% in FEV_1 after exercise indicated a positive result. Overall, the EIB test was unable to identify a source of exercise-induced dyspnea. Importantly, this testing also did not result in positive findings in subjects who had EIB that was subsequently verified by more complex tests.[2] The overwhelming majority (> 80%, $P < .05$) of subjects had no response to the simple challenge testing and therefore required additional testing (Fig. 1). Because the overwhelming majority of subjects who received EIB testing went on to require more complex diagnostic tests, such as comprehensive cardiopulmonary exercise testing, it is unclear what the benefit of EIB testing would be in most patients. Indeed, the authors concluded that their results suggest that EIB testing is inefficient and may not be cost-effective.[2]

Asthma Education

Certified Asthma Educators (AE-Cs) are becoming more common since the advent of the certification in 2002.[3] However, asthma education predates the certification, and many practicing asthma educators remain uncertified. Rice and Mathieson[4] conducted a cross-sectional survey of asthma educators representing a variety of health care professions and compared self-reported practices between AE-Cs and uncertified asthma educators. The authors reported that AE-Cs have a significantly higher adherence to recommended asthma education practices than uncertified educators ($P < .05$; Table 1).[4] Uncertified educators more commonly explained "asthma control" during their education practices than AE-Cs ($P < .05$; Table 1).[4] The authors concluded that although some differences were noted between AE-Cs and non-AE-Cs, overall there were little differences between the 2 groups. However, the study did not account for experience, specialty or level of education.[4] It is difficult to attribute any potential differences or similarities between the 2 groups if these factors are not accounted for (or at least shown to be equivalent between the groups), and this likely has confounded the results. Given that the AE-C was only introduced in 2002, it is possible that most clinicians without the AE-C certification simply have been in the field longer than those with the AE-C certification.[3] Certainly, assessing the actual impact that various credentials have on day-to-day effectiveness in clinical practice is an important effort, and appropriately designed studies could help to reshape future credentialing. However, because Rice and Mathieson[4] omitted important data that likely confounded the results, the findings are less insightful.

pMDI Instruction

Appropriate patient education is recommended for patients receiving treatment via pMDI to ensure the maximum effectiveness of the medication.[3] Improper pMDI usage leads to inadequate delivery of inhaled medications. In the context of rescue usage, improper pMDI technique can be detected more readily because the effects should be immediate. However, inadequate delivery of control medications may go undetected because these medications work over long periods of time and a lack of asthma control may be attributed to factors other than improper pMDI usage. Ferro et al[5] evaluated whether there was a detectable clinical burden in subjects with asthma that could be attributed to improper pMDI usage. They noted that dyssynchrony between pMDI actuation and inhalation was associated with an increase in asthma exacerbations ($P < .05$; Fig. 2).[5] This underlines the importance of proper pMDI technique and the need for high-quality instruction and coaching.

Dabrowska et al[6] evaluated the effects of having pMDI educators correct inappropriate pMDI technique demonstrated by subjects. The study was designed with an intervention group (ie, including pMDI education and technique correction) and a control group (ie, including only pMDI education). After 3 months, the intervention group was

Table 1. Self-Reported Results Between Certified and Noncertified Asthma Educators

Variable	Certified Asthma Educators	Noncertified Asthma Educators	P
1. Explain normal lung anatomy and physiology and the alterations that characterize asthma.	1 (1/3)	2 (1/4)	.003
2. Explain the terms used to characterize asthma (eg, inflammation, bronchospasm, hypersensitive airways).	1 (1/4)	1.5 (1/4)	.14
3. Explain the process that occurs in the lungs during an asthma exacerbation.	1 (1/3)	1 (1/3)	.02
4. Obtain patient and family history.	1 (1/5)	1 (1/5)	.02
5. Perform physical assessment focused on asthma (eg, breath sounds, oxygen saturation, cough, wheeze, shortness of breath, chest tightness).	1 (1/5)	1 (1/5)	.85
6. Obtain objective measures of lung function (eg, peak flow, pulmonary function testing).	2 (1/5)	3 (1/5)	.001
7. Interpret spirometry results.	2 (1/5)	3.5 (1/5)	.002
8. Diagnose asthma.	2 (1/5)	5 (1/5)	.02
9. Perform or interpret the results of bronchial challenge (ie, exercise or inhaled agent such as methacholine).	5 (1/5)	5 (2/5)	.13
10. Assess for coverage of symptoms (eg, cough, wheeze, shortness of breath, chest tightness), patterns (eg, nighttime, exercise, work, exposure), and use of quick-relief inhalers for relief.	1 (1/5)	1 (1/4)	.02
11. Help the patient identify factors that contribute to chronic and acute asthma, like identifying triggers.	1 (1/3)	1 (1/5)	.01
12. Address smoking cessation.	1 (1/4)	1 (1/3)	.61
13. Assess adherence to asthma management or action plan.	1 (1/3)	1 (1/5)	.17
14. Identify patient and family support systems.	1 (1/4)	1 (1/4)	.63
15. Assess psychosocial issues that may affect asthma self-management.	1 (1/4)	1.5 (1/5)	.22
16. Explain the role of allergens and irritants in asthma.	1 (1/3)	1 (1/4)	.16
17. Explain the definition of asthma control and loss of control, and controlled versus not well controlled.	4 (1/4)	2 (1/5)	.041
18. Develop, provide, explain, and/or recommend changes to a patient's asthma action plan.	1 (1/5)	2.5 (1/5)	.001
19. Encourage adherence to the patient's asthma action plan.	1 (1/3)	1 (1/5)	.002
20. Identify when the patient should seek medical attention.	1 (1/2)	1 (1/4)	.001
21. Assess for barriers to adherence with asthma action plan.	1 (1/3)	2 (1/5)	.003
22. Explain the general mechanisms and role in asthma management of quick-relief medications.	1 (1/3)	1 (1/3)	.050
23. Explain the general mechanisms and role in asthma management of long-term control relief medications.	1 (1/2)	1 (1/4)	.049
24. Demonstrate proper use of delivery device for inhaled medication.	1 (1/3)	1 (1/3)	.067
25. Evaluate a patient's ability to properly self-administer inhaled medication.	1 (1/3)	1 (1/5)	.003
26. Dispel misconceptions about asthma medication.	1 (1/4)	2 (1/4)	.02
27. Identify complementary and alternative medications that a patient may be using.	2 (1/5)	2 (1/4)	.61
28. Follow the stepwise approach for asthma medication management.	1 (1/4)	2 (1/5)	.001
29. Develop asthma education programs by performing needs assessment, program planning, program implementing, and evaluating for effectiveness.	2 (1/5)	2 (1/5)	.031
30. Refer a patient to an asthma specialist if needed.	2.5 (1/5)	2 (1/5)	.66
31. Provide, coordinate, or arrange asthma services.	2 (1/5)	2.5 (1/5)	.14

Values are presented as mean (min/max). Mann-Whitney *P* values are reported. All questions were answered on a scale of 1–5, where 1 indicated "always" and 5 indicated "never." From Reference 4.

twice as likely to demonstrate proper pMDI technique compared to the control group ($P < .05$; Fig. 3). However, after 6 months, the intervention group technique declined and was equal to the control group ($P > .05$; Fig. 3). These results highlight the impact of technique correction that goes beyond education and instruction. In addition, because the technique declined after 6 months, subjects may require continuous education and technique correction to maintain pMDI effectiveness.[6]

Taken together, these results emphasize the importance of pMDI instruction and technique, as well as the potential to improve pMDI usage drug delivery. Although the work of Dabrowksa et al[6] did not demonstrate differences in outcomes between the intervention and control groups, the findings of Ferro et al[5] suggest this may be the case because they noted a reduction in overall asthma exacerbations.

RT-Driven Asthma Protocols

Evidence-based protocols for respiratory care are thought to improve patient care by ensuring best-practice adherence and facilitating standardization of care. Asthma care guidelines that promote RT autonomy and seek to streamline therapy have been implemented at a number of institutions.[7] However, there are few data assessing the clinical effectiveness of this process.

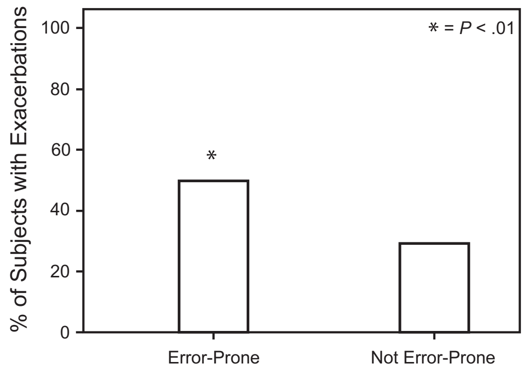

Fig. 2. Asynchrony was associated with exacerbations in 50% of the error-prone cohort. Data from Reference 5.

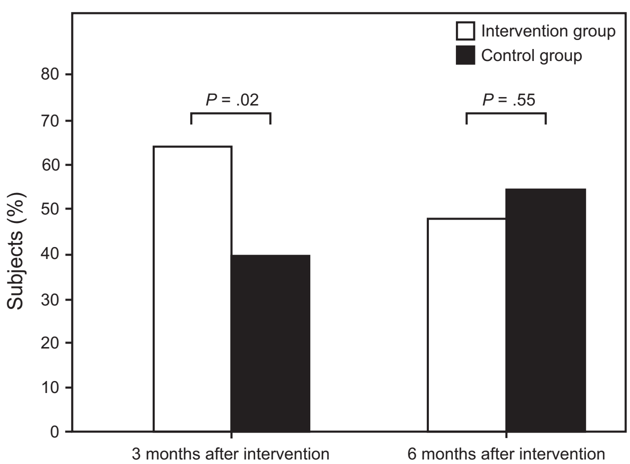

Fig. 3. A significant difference between intervention and control groups was noted after 3 months, but there was no difference after 6 months. From Reference 6.

Maue et al[8] hypothesized that implementation of a continuous albuterol weaning protocol based on the Pediatric Asthma Severity Score (PASS)[9] would decrease albuterol usage without increasing adverse events. The authors did not report a decrease in albuterol usage after implementation of the protocol ($P > .99$), although adverse events also did not increase ($P > .99$). However, their RT staff reported a significant increase in involvement in patient care management decisions, speed of continuous albuterol weaning, and RT input in continuous weaning ($P < .01$; Table 2).[8]

Miller et al[10] conducted a similar study, hypothesizing that implementation of an asthma care protocol based on the Modified Pulmonary Index Score[11] would result in a decrease in total hospital length of stay (LOS), decrease in pediatric ICU LOS, and albuterol usage. They reported a decrease in all 3 of these outcomes ($P < .003$), as well as a significant increase in the use of high-flow nasal cannula ($P < .001$) and noninvasive ventilation ($P < .02$) after implementation of the protocol and a decrease in average subject heart rate ($P < .006$) and breathing frequency ($P < .006$) at admission (Table 3).[10] These differences in supportive therapies and admitted population vital signs may have contributed to the observed decreased in hospital LOS, pediatric ICU LOS, and albuterol usage along with the implemented protocol.

Table 2. RT Role in Management of Patients With Asthma After Implementation of Continuous Albuterol Weaning Protocol

Survey Question	Prior to Intervention	After Intervention	*P*
Is your level of involvement in the management decisions of patients with asthma in the pediatric ICU appropriate?	17 (39.5)	26 (86.7)	< .001
Is the speed at which we wean continuous albuterol in the pediatric ICU appropriate?	14 (32.6)	21 (70)	.002
Is RT input not being incorporated a barrier to weaning continuous albuterol efficiently?	19 (44.1)	5 (16.7)	.01
Is physician availability a barrier to weaning continuous albuterol efficiently?	8 (18.6)	2 (6.7)	.13

Data are presented as *n* (%). From Reference 9.
RT = respiratory therapist

These papers illustrate the feasibility and potential benefits of RT-driven asthma protocols. Neither paper reported an increase in adverse events after protocol, suggesting that RT-driven protocols for asthma management in the pediatric ICU are, at the very least, safe. Maue et al[8] did report a significant increase in RT-involvement in patient care and decision-making. The reductions in hospital LOS, pediatric ICU LOS, and albuterol usage reported by Miller et al[10] suggest that the Modified Pulmonary Index Score may be a useful tool for weaning continuous albuterol.

Asthma Treatment

Treatment options for patients with asthma evolve constantly, both due to improvements of old strategies and discovery of new therapies. Because asthma severity and response to treatment can vary from patient to patient, the ability to individualize strategies to disease management is desirable. We identified 3 papers that discussed inhaled medication delivery methods, new uses of old medications, and treatment strategies for different patient populations.

Gardiner and Wilkinson[12] conducted a randomized clinical trial to compare conventional jet nebulizers with breath-enhanced nebulizers in pediatric patients with acute asthma

Table 3. Findings Before and After Implementation of Asthma Care Protocol

	Prior to Pathway Implementation	After Pathway Implementation	P
Hospital length of stay, d	4.4 (2.9–6.6)	2.7 (1.6–4.0)	< .001
Pediatric ICU length of stay, d	2.1 (1.3–4.0)	1.6 (0.8–2.4)	.003
Readmission to pediatric ICU	0 (0)	1 (0.6)	.57
Discharged directly from pediatric ICU	9 (18)	37 (24)	.34
Received continuous albuterol	44 (90)	124 (81)	.13
Duration of continuous albuterol, h*	39 (25–85)	27 (13–42)	.001
Respiratory support during admission			
High-flow nasal cannula	3 (6)	50 (32)	.001
Noninvasive ventilation	3 (6)	16 (10)	.02
Helium-oxygen mixture	23 (47)	46 (30)	.053
Intubated	0 (0)	2 (1)	.52
Admission data			
Heart rate, beats/min	160 ± 18	152 ± 19	.006
Frequency, breaths/min	45 ± 12	39 ± 13	.006
Temperature, °C	37 ± .45	37 ± 0.49	.56
S_{pO2}	95 ± 4.3	96 ± 3.0	.16
F_{IO2}	0.36 ± 0.24	0.42 ± 0.28	.15
Modified Pulmonary Index Score	N/A	9 (7–12)	N/A

Data are presented as mean (interquartile range), *n* (%), or mean ± SD. From Reference 11.
* *n* = 44 of 124 subjects
N/A = not applicable

exacerbations. They hypothesized that receiving albuterol through breath-enhanced nebulizers would result in a greater increase in FEV_1 compared to conventional jet nebulizers. However, they found a greater increase in FEV_1 in the conventional jet nebulizer group ($P < .04$), suggesting that these devices may be preferable to the more modern, breath-enhanced nebulizers in this patient population.[12]

Beasley et al[13] conducted a multi-center, randomized controlled trial to determine whether budesonide-formoterol would be superior to as-needed albuterol or twice-daily budesonide with as-needed albuterol for adult subjects with mild asthma. They evaluated the number and severity of asthma exacerbations and oral prednisone requirements as outcome measurements. The authors reported that as-needed budesonide-formoterol was superior to as-needed albuterol in all outcome measures ($P < .05$) and was superior to twice-daily budesonide with as-needed albuterol in all outcomes other than the number of annual asthma exacerbations ($P < .05$). The as-needed budesonide-formoterol group also reported less total inhalation of β agonist or budesonide than either of the other study groups ($P < .05$).[13]

Wechsler et al[14] conducted a multi-center, randomized controlled trial to evaluate the effectiveness of escalating doses of inhaled glucocorticoids and long-acting β agonists in black children with poorly controlled asthma. In contrast to similar studies in white children and black adolescents and adults, black children with poorly controlled asthma had a superior response to a quintupling in the dose of inhaled glucocorticoids ($P < .05$). This population responded more positively to increased glucocorticoids compared to simply adding a long-acting β agonist.[14]

It certainly appears that asthma treatment has been shaken up in the past year. The reports from Beasley et al[13] and Wechsler et al[14] challenge what has long been standard care for asthma treatment. Budesonide-formoterol has almost exclusively been used as a maintenance therapy, but the report from Beasley et al suggest a potentially important role as a rescue inhaler. Wechsler et al[14] were able to identify a cohort of children with asthma who responded to a quintupled inhaled glucocorticoid dose. These well-designed, creative investigations elucidated results that improve our ability to cater asthma management to our individual patients and ultimately improve outcomes.

Summary

In the past year, there have been a number of important developments in the effectiveness of diagnostic testing, patient education and coaching, nebulizer efficiency, and novel treatment strategies to improve care of patients with asthma. Asthma care is constantly evolving as old therapies and paradigms are improved and challenged. Updating practice based on new discoveries and publications is challenging due to this constant evolution, but it is necessary to provide the best care to patients.

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