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Case Report

Improving Health Literacy for People with Severe Cognitive Impairment: a Case Report in Asthma Testing and Diagnosis

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Abstract

Background: People with intellectual disability have limited access to diagnostic procedures due to poor collaboration and inability to understand instructions. There is a need to render diagnostic services more accessible to individuals with intellectual disability to ensure them the best possible level of clinical management. In the case of suspected asthma and a patient's inability to perform Spirometry, Impulse Oscillometry (IOS) can be used to confirm the diagnosis.

Objective: Our aim was to identify strategies to improve the performance of Impulse Oscillometry in a patient with severe cognitive disability and to confirm the clinical suspicion of asthma.

Materials and Methods: To ensure the patient's maximum level of active participation personalized instruction and training were provided prior to the actual exam in order to familiarize him with the procedure. The exam was conducted according to technical standards published in 2020 by the European Respiratory Society for Respiratory Oscillometry.

Results: A 41-year-old patient with severe intellectual disability, a recent episode of Covid 19 pneumonia and suspected asthma performed an initial IOS test which did not allow for confirmation of the diagnostic hypothesis.

The second IOS test, conducted following a one-month period of training, confirmed the diagnosis of asthma.

Conclusions: The difficulties encountered by the patient in performing the IOS test efficiently were resolved by implementing adapted training strategies to meet the patient's special needs, without compromising test quality.

ABBREVIATIONS

AX: Area Of Reactance; BD: Bronchodilation; BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease; CT: Computed Tomography; Diff R5-R20: Difference Of Resistance Between The Two Frequencies; ERS: European Respiratory Society; Fres: Resonant Frequency IOS: Impulse Oscillometry; IVH: Intraventricular Hemorrhage; LABA/ICS: Long-Acting Beta2-Agonist (Laba) And Inhaled Corticosteroid (ICS); ODE_4: Drop In Spo2 By At Least 4% For A Minimum Duration Of 10 Seconds; ODI_4: Oxygen Desaturation Index Adjusted For Artifacts (Ode4/Hours Of Sleep); OT: Occupational Therapist; R5: Resistance At Frequency Of 5 Hertz; X5: Reactance At Frequency Of 5 Hertz; IRB: Institutional Review Board.

INTRODUCTION

The CDC 2020 updated definition of personal health literacy places emphasis on individual capacity to access and utilize information and services to facilitate health-related decisions and actions [1].

People with high health literacy tend to have a higher health status; on the contrary, people with severe intellectual disability, who usually demonstrate very limited active participation in diagnostic procedures, are at an increased risk of chronic diseases due to inadequate levels of personal health literacy and poor ability to collaborate [2-4].

Health care providers have a unique responsibility towards this vulnerable patient population to render diagnostic procedures as accessible and simplified as possible in order to facilitate appropriate clinical decision-making when determining effective treatment interventions [2-5].

A diagnosis of asthma via spirometry may be difficult in the individual with severe intellectual disability since it is a technique requiring maximum cooperation by the patient via effort-dependent maneuvers with good coordination [6-8].

Impulse Oscillometry (IOS) is an alternative technique for asthma diagnosis. Since it is performed on tidal breathing, IOS requires minimal patient cooperation [9]. It is used to study a variety of respiratory disorders in addition to asthma, such as COPD and interstitial lung diseases, in both pediatric and elderly patients [9-11].

IOS differentiates between small airway obstruction and

large airway obstruction and it is useful in measuring response to bronchodilators [9-11]. IOS values are correlated with clinical symptoms and asthma control [10-11].

A limitation of IOS in the intellectually disabled is that, although the procedure is effort-independent, in order for valid results to be obtained a minimal degree of cooperation and coordination is still required [10].

New technical standards have been published for respiratory oscillometry in 2020 by the European Respiratory Society updating previous standards dating back to 2003 [12].

Our goal was to evaluate an approach aimed at improving the feasibility of Impulse Oscillometry in a subject with severe cognitive impairment and asthma-like symptoms post-hospitalization for Covid-19 pneumonia.

METHODS

We analyzed clinical data of a 41-year-old resident of the "Istituto Serafico" of Assisi, Italy. An initial visit and a one-month follow-up visit were conducted after the resident presented with symptoms compatible with asthma status post Covid 19 pneumonia [13]. Instant daytime and overnight pulse oximetry tests were executed with Sat 900 pulse oximeter (Contec Medical Systems Co. Ltd.): the instant oximetry test during both day-time visits, and the overnight oximetry test during the nights following each visit. Impulse oscillometry was performed with Jaeger Vyntus® IOS (Vyaire Medical, Inc.), adhering to the updated technical standards for respiratory oscillometry published by ERS in 2020.

An occupational therapist on staff was consulted after the first IOS test due to the difficulties the resident had demonstrated in performing the test which contributed to a low level of accuracy in the test results. In order to assure maximum collaboration and improve the degree of coordination the therapist worked with the resident twice a week for four weeks prior to the scheduled date of the second IOS test and provided personalized training which consisted of introducing the mouthpiece and the nose clip and providing instructions for breathing. Various adaptive teaching strategies supported in the literature on intellectual and visual disability were utilized, starting with tactile exploration of the accessories used in the test [14]. Chaining techniques were also utilized in order to facilitate the resident's understanding of what was expected during the exam, as well as familiarize him with the various steps involved, with the goal of maximizing his comfort level and minimizing any possible agitated responses during the actual exam [15]. Each step of the exam procedure was introduced utilizing a progressive, sequential learning approach. The procedure was broken down into small "learning tasks". This avoided overwhelming the resident during the training period. Once the resident mastered one step, the next step was introduced.

During the actual exam the resident was seated in an upright sitting position and was assisted by the doctor in maintaining correct head position, cheek support and mouthpiece seal. The occupational therapist assisted the resident by providing clear and simple instructions tailored to his level of understanding and based on generalization obtained from the sequential learning approach. In addition, the therapist provided tactile cues during the exam by laying a hand on the resident's abdomen. This intervention served a dual purpose of constantly reassuring the resident, while assisting him in understanding the location of where and how much force to exert in performing the inhalation/exhalation pattern. An exemption from IRB approval of the study protocol was granted by the author's institution as it was a retrospective study, and the evaluated medical device had already been approved for clinical use.

RESULTS

The resident of the "Istituto Serafico" of Assisi was diagnosed with interstitial bilateral pneumonia secondary to SARS CoV2 during an outbreak of Covid 19 that occurred in the Institute in December 2020, and he was admitted to the Department of Internal Medicine of Foligno Hospital with dyspnea, oxygen desaturation and fever.

His medical history included severe cognitive impairment and spastic tetraparesis due to IVH secondary to severe prematurity, blindness secondary to retrolental fibroplasia, behavioral disorders with psychotic traits, liver fibrosis in treated HCV chronic hepatitis and previous history of recurrent episodes of urticaria; no symptoms compatible with asthma had been noted prior to this hospitalization.

Upon hospital admission he was alert, presenting with dyspnea and tachypnea and oxygen desaturation (SpO2 88% on room air at rest), his blood gas analysis (ABG) performed with oxygen therapy (FiO2 40%) revealed: PaO2 97 mmHg, PaCO2 37 mmHg, PaO2/FiO2 Ratio 242, pH 7, 43, HCO3- 24.6 mmol/l.

Computed tomography (CT scan) of the lungs revealed scattered, small ground-glass opacities bilaterally. During hospitalization he was treated with oxygen, dexamethasone, ceftriaxone, remdesivir and enoxaparin, with overall improvement of his respiratory function.

At the one-month follow-up visit post-hospital discharge his body temperature was 36.1°C, pulse rate 107 bpm, respiratory rate 20 breaths per minute, blood pressure 145/85 mmHg, SpO2 98% on room air at rest; the patient's height was 144 cm, weight 63 kg and BMI 30 kg/m^2.

Prolonged expiration and diffuse bilateral wheezing were heard on chest auscultation, most noted in the middle and lower lung fields, with diminished breath sounds at the lung bases.

Impulse oscillometry test (IOS) was performed before and after bronchodilation (BD) with inhaled salbutamol 400 mcg.

In view of the resident's blindness and severe intellectual disability, the initial approach to performing impulse oscillometry aimed to ensure a calm setting, a sufficient amount of time to familiarize the resident with the procedure, and an explanation adapted to his cognitive level.

A sufficient level of collaboration was observed during the pre-BD test, with results deemed of acceptable quality. However, the post-BD test was inferior in quality due to a poor level of cooperation with an excessive impedance variability and

Table 1: IOS results.

	Predicted	First IOS test (before OT intervention)				Second IOS test (after OT intervention)			
		Pre BD	% Pre/ Theor	Post BD	% Post/ Pre	Pre BD	% Pre/ Theor	Post BD	% Post/ Pre
R_5 (kPa*s*L^{-1})	0.28	0.48	170	0.57	121	0.61	218	0.30	49
X_5 (kPa*s*L^{-1})	0.01	-0.13	-2204	-0.12	95	-0.15	-2644	-0.05	33
AX		0.72		0.31		0.81		0.10	
Fres (Hz)		18.67		11.88		17.60		9.30	
Diff R_5-R_{20} (kPa*s*L^{-1})		0.05		0.04		0.09		0.02	
Tidal Volume (L)	0.44	0.56	126	0.84	151	0.72	159	0.45	63

AX: Area of reactance; BD: bronchodilation; Diff R5-R20: Difference of resistance between the two frequencies; Fres: Resonant frequency; IOS: Impulse Oscillometry; OT: Occupational Therapist; R5: Resistance at frequency of 5 Hertz; X5: Reactance at frequency of 5 Hertz

Table 2: Overnight pulse oximetry results.

	First test	Second test
Exam Duration	9 h, 15'	8h, 43'
Mean SpO2 value	93,3%	94,1%
Percentage of total test time with SpO2 >95%	15,1%	40,6%
Percentage of total test time with 90%< SpO2 < 95%	83,5%	58,5%
Percentage of total test time with 85% < SpO2 < 90%	1,3%	0,8%
Percentage of total test time with SpO2 < 85%	0,1%	0,1%
ODE_4	59	46
ODI_4 (adjusted index)	6,5 / hour	5,6 / hour
Number of ODE with SpO2 < 90%	11	5

Desaturation event (ODE4): drop in SpO2 by at least 4%, for a minimum duration of 10 seconds
ODI4: oxygen desaturation index adjusted for artifacts (ODE4/hours of sleep)

contradictory results: higher values of Resistance at 5 Hz (R5) and Reactance at 5 Hz (X5) and lower values of Area of reactance (AX) and Resonant frequency (Fres).

Even if the results of IOS test did not allow for a definitive diagnosis of asthma, the patient's medical history and physical examination were suggestive of asthma and inhaled LABA and ICS was started (Beclometasone/Formoterol, 100mcg/6mcg b.i.d.).

The intervention provided by the OT following the first IOS test was aimed at familiarizing the patient with the exam procedure in order to ensure more active participation and collaboration during the second IOS test, with the goal of improving test accuracy.

At the second follow-up visit one-month post-onset of therapy the resident presented with less wheezing, but slightly diminished breath sounds at lung bases persisted; his body temperature was 36.5°C, pulse rate 92 bpm, respiratory rate was 16 breaths per minute, blood pressure 135/85 mmHg and SpO2 96% on room air at rest.

The second IOS test allowed for a definitive diagnosis of asthma according to the updated European Technical Standards for Respiratory Oscillometry: -51% (at least −40%) in R5, +67% (at least +50%) in X5 and -88% (at least −80%) in AX in the post-BD test as compared to the pre-BD test.

At the same time the test showed that the resident had not yet reached good asthma control even if symptomatology and physical examination were improved: Pre-BD values of R5 > 140% of predicted and Diff R5-R20 0.09 kPa*s*L-1.

Table one demonstrates the differences in the IOS test results before and after OT intervention.

The overnight pulse oximetry tests performed the nights following the first and the second follow-up visits revealed a weakly significant positive trend with an increasing mean value of SpO2 (from 93,3% to 94,1%) and prolonged time with SpO2 >95% (from 15% to 40% of the total test time).

Table two illustrates the overnight pulse oximfetry results described above.

The follow-up computed tomography scan (CT) did not reveal any parenchymal opacities of the lungs or pleural effusion or enlarged mediastinal lymph nodes.

DISCUSSION

People with cognitive impairment experience increased difficulty in accessing healthcare services. These systemic differences place them at a disadvantage affecting health status and health outcomes [16].

To our knowledge, this is the first reported diagnosis of asthma made by utilizing IOS for an individual with severe intellectual disability.

Despite the difficulties due to the resident's visual deficit and low level of collaboration and coordination we refused to resign ourselves to having an inaccurate diagnosis of asthma, considered probable but not definitive, based on the initial IOS test.

By implementing adapted training strategies, the resident was allowed the time to familiarize himself with the mouthpiece and the nose clip and to better understand the exam procedure as well as coordinate his breathing pattern. This resulted in an improved level of performance which allowed for a precise diagnosis with a level of technical quality comparable to that obtainable from the general population.

It is important to emphasize that all conditions during each test administration were maintained except for the training and support provided by the Occupational Therapist: both the first and second IOS tests were carried out in the same setting, utilizing the same equipment, and conducted by the same doctor.

The accuracy of the test increased to the point of permitting the diagnosis of asthma to be made at one-month post-onset of specific therapy with LABA/ICS.

This case report demonstrates how proper planning and incorporating adaptations in clinical exam protocols can allow disabled patients to perform tests which at first may be perceived as inaccessible to them.

A shift in perspective is necessary and long overdue. As health care professionals we should not immediately give up in front of the difficulties that individuals with severe disabilities present while performing necessary clinical tests in "standard mode". Rather, we need to think "outside the box" by being creative and exploring all feasible, innovative, and sometimes even simple strategies to tailor these diagnostic tests to our patient population, with the goal of making them as accessible as possible while simultaneously assuring the highest standards of precision and quality.

CONCLUSIONS

Patient-centered care of individuals with intellectual disability requires a multidisciplinary approach as well as a concerted effort to communicate, collaborate, and coordinate health care information and address essential needs when facilitating diagnostic procedures. In order for these individuals to collaborate in an appropriate manner during IOS it is imperative that prior to the actual procedure they become familiar with what is expected of them by tailoring instruction and training to promote generalization.

Individualized adaptations for individuals with intellectual disability can ensure a smooth flow of information and promote optimal outcomes in this vulnerable population.

This case report highlights the possibility of performing respiratory clinical tests in individuals who are intellectually impaired by implementing adapted teaching strategies and approaches sensitive to individual strengths and weaknesses while personalizing timing and methodology, with the goal of obtaining accurate and reliable results. Other clinical tests could also be adapted for individuals with decreased levels of collaboration in order to facilitate the formulation of diagnoses impacting medical management and quality of care.

CONFLICT OF INTEREST

All Authors declare that they have no conflict of interest and that they have all contributed to, reviewed, and approved the case study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

AUTHOR CONTRIBUTIONS

Conceptualization: GC; Investigation: GC, SC; Writing-Original draft: GC, SC, OC, SE. All Authors contributed to manuscript revision and approved the final version.

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