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Thesis

It is Time to Provide a Proper Training on Pulmonary Function Tests in Secondary Care Hospitals in Developing Countries

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Abstract

Background: Pulmonary function tests are important as an investigation and monitoring for patients with respiratory diseases. The use of Spirometry will confirm the diagnosis of Chronic Obstructive Pulmonary Diseases, when showing an irreversible obstructive pattern, while an airway obstruction is usually reversible as in asthma.

Spirometry also shows a restrictive pattern in interstitial lung diseases.

However, performing spirometry test require a good technical experience. If the shape of the spirometry time-volume tracing or Flow volume curve shows abnormalities, this is an indication of false technique and this may lead to a false diagnosis.

Methods: We reviewed a random sample of 100 spirometry tracing tests performed in a first level secondary care hospital, and tracked errors in performing the spirometry. Those errors were classified into five categories in consistence with the international standard:

1- Slow start
2- Sudden cut off (When expiration stopped before reaching the forced vital capacity level)
3- Sub maximal effort (Peak Expiratory Flow sub-optimal)
4- Irregular tracing: Cough, or extra-breath
5- Bad inspiration curve.

Results: From the investigated group: 4% showed slow start, 40% sudden cut off of forced expiration, 53% showed sub-optimal effort for Peak Expiratory flow, 17% cough or extra-breath, bad inspiration curve in 81% and only 10% showed normal tracing

Conclusion: On review it appeared that 90 spirometry tests were classified as bad tracing out of 100 tests, accordingly we feel that it is time to raise the alarm for this dilemma and plan a proper training for those involved in performing lung function tests at all levels, especially in the first level referral hospitals.

More important, and if the health care worker who supervises spirometry tests fail to recognize bad tracing, and in this case it is presumably that the physician involved in the management of those patients can't rely on those spirometry false results, and demand a repetition of Lung Function Tests properly.

Otherwise a diagnosis of restrictive pulmonary or COPD can't be made promptly.

In developing countries spirometers in primary and secondary care hospitals, are not always available as well as there is an absolute need for good training to depict technique errors.

Keywords: *Pulmonary Function Tests; Spirometry; Chronic Obstructive Pulmonary Diseases; Asthma*

Introduction

Pulmonary function tests (PFTS) are an important tool in the investigation and monitoring of patients with respiratory pathology. They provide an important information relating to the large and small airways and the pulmonary parenchyma. Although they do not provide

a diagnosis per se, different patterns of abnormalities seen in various respiratory diseases that helps to establish a diagnosis [1-5]. In our paper we describe how health professional should be trained to recognize errors in performing PFTS, if not this could lead to abnormal results when there are not, or to false diagnosis.

A sitting position is typically used at the time of testing to prevent the risk of falling and injury in the event of a syncopal episode, although PFTS can be performed in the standing position. Patients are advised not to smoke for at least one hour before testing, not to eat a large meal two hours before testing and not to wear tight fitting clothing as under these circumstances results may be adversely effected [2,3].

Normal or predicted ranges of values are obtained from large population studies of healthy subjects. Values are taken for people matched for age, height, sex and where appropriate ethnicity. PFTS should be performed and repeated until obtaining three reproducible and accurate tracing, the best FEV1 and FVC should be considered even if not from the same tracing or curve [3-5].

In primary, and at first level secondary care, we focus on spirometry: Time-volume tracing, and flow volume curves [1-5].

Spirometry is the most frequently used measure of lung function and is a measure of volume against time [1-5]. It is a simple and quick procedure to perform: patients are asked to take a maximal inspiration and then to forcefully expel air for as long and as quickly as possible (a forced vital capacity maneuver). Beside volume time spirometry tracing, The flow volume curve tracing give the values of FEV1, FVC and other measurements like Peak Expiratory Flow Rate (PEF) and forced inspiration tracing [2,4,5].

Both methods give us the calculation of Forced Expiratory Volume in one second (FEV1), Forced Vital Capacity (FVC) and FEV1/FVC%, this allows us to the identification of obstructive or restrictive ventilatory defects. A FEV1/FVC < 70% where FEV1 is reduced more than FVC signifies an obstructive defect. Common examples of obstructive defects include chronic obstructive pulmonary disease (COPD) and asthma in crisis. The FEV1 can be expressed as percentage of the predictive value which allows classification of the severity of impairment, it is considered abnormal when < 80% predicted [3]. While FEV1/FVC > 70% with FVC is < 80% and FVC reduced more than FEV1 confirm a restrictive defect such as interstitial lung diseases (e.g. idiopathic pulmonary fibrosis) and chest wall deformities.

As we said above, there are rules for the execution of lung functions. Respect of these rules, give us a good shaped spirometry tracing and good shaped flow volume curve. These shapes should be checked by the physician for conformity before accepting the results of measured PEF, FEV1, FVC and inspiration values.

Technicians should be trained for correct performance of spirometry.

And clinicians should be trained to recognize bad tracing, resulting from bad technique, which could be responsible of diagnosis errors [3-5].

In this survey we wanted to track errors committed in tracings and comment on it. For this purpose we choose 100 tracing randomly selected in a first referral level of secondary care. Patients either came directly or are referred from primary care setting,

Methods

We took a random sample of one hundred lung function tracing from a first level secondary care patients' files.

We checked for those errors appeared in tracings.

We classified errors into five categories according to international criteria [3,4]:

1- Slow start
2- Sudden cut off (When expiration stopped before reaching the forcing vital capacity level, the patient can expire longer time)
3- Inconsistent, sub maximal effort (PEF sub-optimal)
4- Irregular tracing: Cough, or extra-breath
5- Bad inspiratory curve.

Ethics review

Ethical approval was secured from hospital institutional board.

Results

All tracings are available on this link: https://www.dropbox.com/sh/atzhnlxaszvns2p/AACMBwuztjwRRlDHf1dRK6sva?dl=0.

Our results are given in percentage of errors in the following table.

Type of error	Major misdiagnosis probability	Corresponding Spirometry values		
Slow star: 14	Restrictive over diagnosis	FEV1/FVC < 70% in 0	FEV1 < 80% in 3 patients	FVC < 80% in 6 patients
Sudden cut off of forced expiration: 40	Obstructive under diagnosis	1	20	27
Inconsistent, suboptimal. Effort: 53		2	17	25
Irregular tracing (cough or extra breath): 17		2	5	7
Inspiration curve shows bad tracing: 81		11	42	47
Normal Tracing: 10				

Curves with only one error: 16, two errors: 14, three errors: 29, four errors: 31, five errors: 4.

Discussion

Health professionals in the primary care units need training for spirometry. And, clinicians who read the results, should watch if the tracing is acceptable. If not they should refuse the test [3-5].

For acceptable test, the following rules should be respected strictly, when explaining to the patient how to do:

1- Instruct the patient to breathe in fully until the lungs feel full.

2- The patient should only hold their breath long enough to seal their lips tightly around the mouthpiece.

3- Blast the air out as forcibly and fast as possible until there is no more air left.

4- Check that an adequate trace has been achieved.

5- Repeat the procedure - you need three acceptable blows within 150 mL or 5% of each other.

6- Record the best readings of FEV1 and FVC in these three tracing even if from different tracing.

If any of these instructions is not well known by health professional leading the patient for achieving spirometry or flow-volume loop. This will result on bad inspiration or inconsistent expiratory maximal sustainable effort, especially if slow beginning or early cut off of forced expiration, or when cough or extra-breath.

Fortunately bad technique is visible on the tracing, this shows a perturbed shape [3-5].

More important, and if the health care worker who supervise spirometry blows tests miss to recognize a bad tracing, in this case the resident internal medicine practitioner who is treating the patients based on spirometry results, should have a critical view on bad tracing and send the patient back to repeat Lung Functions Test.

We have 90 bad tracing out of 100, It is time to clock the alarm and plan training for lung functions at all levels.

This is recommended by all health authorities [6-8].

Diagnosis of major chronic respiratory diseases, especially asthma and COPD are relying on lung functions tests.

COPD is present only when FEV1/FVC is < 70% after bronchodilators and asthma hallmark is reversibility.

While restrictive diseases like interstitial lung diseases are diagnosed if FVC < 80% and FEV1/FVC > 70%.

If bad technique and bad tracing, Lung Function Test will be misleading.

The most shocking example as you see if there is early cut off, obstructive will appear restrictive because FVC is limited by incomplete expiratory efforts.

And if slow beginning FEV1 will diminish and obstruction will be diagnosed when not existing.

We attached all the curves for training purpose: https://www.dropbox.com/sh/atzhnlxaszvns2p/AACMBwuztjwRRlDHf1dRK6sva?dl=0.

Conclusion

We surveyed 100 spirometry tracing in a first level secondary care hospital, and we were surprised to see that only 10% of these tracings were acceptable. While for the other 90% tracings one or more error was depicted. 4% showed slow start, 40% sudden cut off of forced expiration, 53% showed sub-optimal effort for Peak Expiratory flow, 17% cough or extra-breath, and bad inspiration curve in 81%.

In developing countries, spirometry is rarely available at primary care level [7], while we encourage spirometers to be distributed at primary care levels, according to our results we first should stress on good and efficient training, and continuing medical education at first referral level hospitals.

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