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Clinical, operational and economic outcomes of point-of-care blood gas analysis in COPD patients

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ABSTRACT

Introduction: Arterial blood gas analysis is relevant in chronic obstructive pulmonary disease (COPD) management. The aim of this study was to evaluate whether the use of a blood gas analyzer in pulmonology departments improves the clinical, operational and economic outcomes when compared with clinical laboratory measurements.

Patients and methods: It is an observational prospective study. 112 patients were selected. After specimen collection, the measurement was performed both in pulmonology office as point-of-care and in laboratory. We evaluated clinical outcomes (modification of the indication of long-term oxygen therapy (LTOT) according to results, changes in blood gas analysis results, relationship of the partial pressure of oxygen (PaO_2) obtained in the medical visit and velocity of change of the PaO_2, influence of total haemoglobin concentration and the change in PaO_2), operational outcomes (turnaround time (TAT) from specimen collection to receiving the blood gas analysis report) and economic outcomes (overall cost per process of patient care).

Results: There were discrepancies in the indication of LTOT in 13.4% of patients. All parameters showed changes. PaO_2 levels showed changes in 2 ways, though they frequently increase over time. The correlation was not good in the other two clinical outcomes. The median TATs in pulmonology office were 1 min versus 79 in laboratory, with 52 min for specimen preparation and transport and 17 min for TAT intralaboratory. The overall cost for the 112 patients in pulmonology office and laboratory was 16,769.89€ and 22,260.97€ respectively.

Conclusions: The use of a blood gas analyzer in a pulmonology office improves clinical, operational and economic outcomes when compared with clinical laboratory.

Introduction

Point-of-care testing (POCT) refers to laboratory diagnostic testing determined outside the clinical laboratory, in a setting near where the patient is being treated [1]. At present, POCT is expanding. Despite its potential benefits such as reduced turnaround time (TAT) or fewer preanalysis errors due to the simplification of processes, there are few studies that have assessed its impact. Several lines of research are therefore currently aimed at determining the implications of POCT for the clinical, operational and economic outcomes of patient care [2,3].

Blood gas analysis is an important part of POCT. Most studies that have addressed the potential benefits of POCT blood gas analysis have considered intensive care units, emergency departments or cardiac surgery units [3]. However, arterial blood gas analysis is also relevant in the diagnosis of chronic respiratory failure and long-term oxygen therapy (LTOT) monitoring conducted in pulmonology departments [4]. Chronic obstructive pulmonary disease (COPD) is amongst these processes. We designed this study considering the relevance of blood gas analysis in COPD management and in the indication for LTOT, the growing interest in improving care for these patients and the lack of research providing evidence on the implications of performing POCT blood gas analysis in this setting.

In this study, we evaluate whether the use of a blood gas analyzer in pulmonology departments improves the clinical, operational and economic outcomes related to the care of outpatients with COPD in stages III to IV (according to the Global Initiative for Chronic Obstructive Lung Disease [GOLD] criteria), [5,6] when compared with clinical laboratory measurements.

Patients and methods

This was a single-center, observational prospective study that assessed differences in care for outpatients of a doctor's office in the Department of Pulmonology at the La Paz University Hospital, Madrid,

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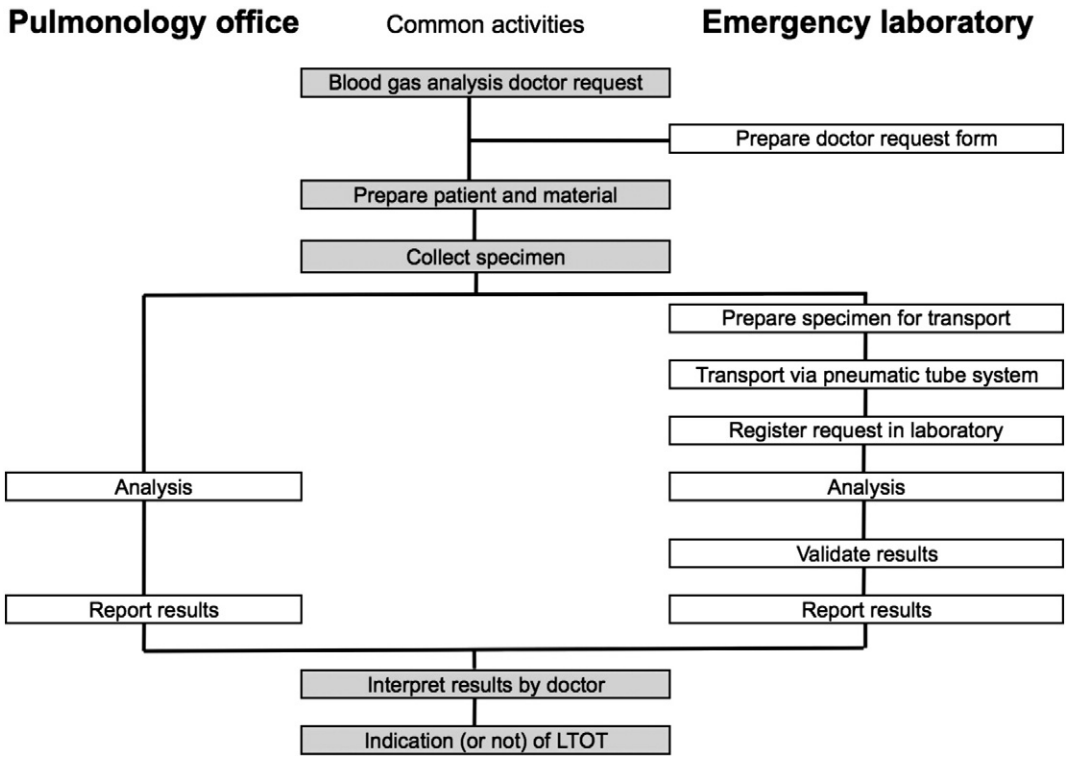

Fig. 1. Stages involved in the care process in pulmonology office and in emergency laboratory.

Spain, when the blood gas measurement was conducted during the same visit as POCT or when performed in the emergency laboratory of the Department of Laboratory Medicine of the same hospital. The stages involved in the care process for each unit are shown in Fig. 1.

The aspects considered to assess the impact were the following:

Clinical outcomes

A. Modification of the indication of LTOT
B. Difference between POCT and emergency lab blood gas analysis results
C. Relationship of the partial pressure of oxygen (PaO_2) measurement in the medical visit and the velocity of change of the PaO_2
D. Influence of total haemoglobin concentration and the change in PaO_2

Operational outcomes

E. TAT from specimen collection to receiving the blood gas analysis report

Economic outcomes

F. Overall cost per process of patient care

A total of 112 patients who visited the doctor's office within a period of 10 months were selected according to the following criteria:

Inclusion criteria: Signing the informed consent, men and women older than 18 years, stages III to IV COPD and an indication for arterial blood gas measurement.

Exclusion criteria: Presence of respiratory diseases other than COPD, treatment with oxygen therapy in the 30 min prior to the blood collection for blood gas analysis, anticoagulant treatment and an inability to collect a specimen for blood gas analysis.

Withdrawal criteria: Patients who decided to withdraw their consent at any time during the study and patients who could not complete the protocol due to the collection of insufficient or inadequate specimens.

Ethical criteria: The study was approved by the Clinical Research Ethics Committee of the La Paz University Hospital. All patients signed an informed consent document. The study was performed according to good clinical practice standards.

Patients who visited the doctor's office during the study period to undergo an arterial blood gas measurement and who met the inclusion and exclusion criteria were given with the patient information sheet and briefed on its contents. The patients then signed the informed consent document.

An arterial blood specimen was then collected in a BD Preset™ plastic syringe (Becton Dickinson®) with lyophilized lithium heparin and then measured in a blood gas analyzer located in the doctor's office. The specimen was first visually checked to ensure that there were no air bubbles and then was properly homogenized for 1 min, inverting and rolling, and manually purged (no filter or other device was used). The blood gas results were obtained immediately after the measurement. These results were used for patient care following the standard clinical practice.

Though it was not the daily routine practice, we studied the process as if there was no blood gas analyzer in doctor's office as a simulation experiment. Thus, once the specimen had been processed in the doctor's office, it was once again purged to avoid the incorporation of air bubbles that could change the subsequent results. The specimen was then immediately sent with the corresponding doctor request form the emergency laboratory. After the request was made and the specimen was registered, the specimen was first checked for bubbles and once again homogenized and purged before performing the measurement. The information related to the processing both in the doctor's office and in the laboratory was stored in the laboratory information system (LIS) for subsequent analysis.

At the beginning of the study, the pulmonology office had a RapidPoint 405 blood gas analyzer and the emergency laboratory had 1 RapidPoint 405 and 2 RapidLab 1265 analyzers, both from Siemens Healthcare Diagnostics®. The study was conducted with this equipment for the first 91 patients. There was a subsequent