BASE EXCESS, A MARKER OF CHRONIC HYPERCAPNIC RESPIRATORY FAILURE AND PREDICTOR OF SURVIVAL IN COPD
Stephan Budweiser, MD*, Rudolf A. Jörres, PhD†, Theresa Riedl*, Frank Heinemann, MD* and Michael Pfeifer, MD‡

*Center for Pneumology, Donaustauf Hospital, Donaustauf, Germany
†Institute and Outpatient Clinic for Occupational and Environmental Medicine, Ludwig-Maximilians-University, Munich, Germany
‡Dept of Internal Medicine II, University of Regensburg, Regensburg, Germany

WINNING ABSTRACT: We studied the role of base excess (BE) as marker of chronic hypercapnia and survival in patients with chronic obstructive pulmonary disease (COPD) and chronic hypercapnic respiratory failure (CHRF). Moreover, it was investigated whether the effects of non-invasive positive pressure ventilation (NPPV) on CHRF were reflected in BE and survival.

In 240 (160 without exacerbation) patients with COPD (mean ± SD FEV1 30.7 ± 9.7 %pred; PaCO2 56.9 ± 9.9 mmHg) body-mass index (BMI), lung function, respiratory muscle function, blood gases and 6-minute walking distance (6-MWD) were assessed prior to initiation of NPPV. In addition, the changes of risk factors 6.3 ± 2.9 months after initiation of NPPV were evaluated.

Overall mortality during the follow-up time (26.0 ± 24.5 months) was 34.6%. Deaths resulted predominantly from respiratory causes (65.1%); among those, respiratory failure was most frequent (85.2%). Univariate analysis revealed BMI, FEV1, maximal inspiratory pressure (PImax), inspiratory load (Pn.1), haemoglobin, 6-MWD, hyperinflation (IC/TLC, RV/TLC), blood gases and BE to be associated (p < 0.05 each) with prognosis. In multivariate analyses, however, only BMI, RV/TLC and BE turned out to be independent cross-sectional predictors (p < 0.05). Kaplan-Meier analyses showed that BE had predictive value particularly in patients with BMI ≥ 25 kg m⁻², RV/TLC ≥ 70 % and PaCO2 ≥ 57 mmHg. Furthermore, changes of BMI, RV/TLC and BE (p < 0.01) were associated with improved prognosis in severe hypercapnic COPD.

In patients with COPD and CHRF, BE was a prognostic marker for mortality, that was independent from other factors, particularly PaCO2. In addition, reversal of CHRF was reflected in BE and appeared to have an impact on prognosis.
interest on long-term survival and prognostic factors. Although hypercapnia is often associated with advanced lung diseases, its predictive role per se for survival [8, 9] and the impact of a reduction in arterial carbon dioxide tension (PaCO₂) by NPPV is still a topic of controversy [10]. Usually, CHRF is assessed via the determination of daytime PaCO₂, which is prone to fluctuations depending on the patient’s momentary condition and inspiratory drive. In contrast, base excess (BE), representing the degree of metabolic compensation of respiratory acidosis, is probably a more stable marker due to the inertia of the compensatory mechanisms [11]. In the present study, we investigated the role of BE as a marker for CHRF and its predictive value for long-term mortality in patients with chronic obstructive pulmonary disease (COPD). In addition to established or recently proposed prognostic markers, such as forced expiratory volume in one second (FEV1), body mass index (BMI), 6-min walking distance (6-MWD), lung hyperinflation and laboratory parameters, we put special emphasis on BE. We investigated the predictive value of these markers either at baseline prior to NPPV or of their changes after initiation of NPPV.

The present study addressed long-term survival and prognostic factors in patients with COPD and CHRF under NPPV. It covered a 10-yr observation period and a mean follow-up time of ~26 months and is one of the largest investigations dealing with this issue.

MY RESEARCH AS PART OF MY WORKING GROUP/RESEARCH TEAM

In accordance with previous studies [12], BMI was a strong predictor of mortality, as well as lung hyperinflation in terms of inspiratory capacity/total lung capacity (TLC) and residual volume/TLC [13]. As the major novel finding of our study, we revealed BE to be a significant and consistent predictor of long-term mortality in patients with severe COPD and CHRF. Even more interesting seemed to be the results of conditional analyses of subgroups, which were either at particular risk or not, according to one of the previously known risk factors. This type of analysis revealed that BE was predictive only in some subgroups of patients, i.e., under the condition that certain other requirements were satisfied. We believe that this type of conditional analysis bears the potential for significant future refinement of risk scores, which in many cases are additive and do not adequately take into account interactions between risk factors.

Another conclusion from our data relates to the long-term benefit of NPPV. This has not been satisfactorily clarified [10] compared with the clear-cut results and corresponding recommendations in acute respiratory failure [14]. Beneficial effects of NPPV on blood gases, particularly a reduction of PaCO₂ have been demonstrated in patients with high inspiratory pressure levels [1, 15, 16]. While chronic hypercapnia implies poor survival, it is not clear whether its reversal, once hypercapnia has developed, results in an improved long-term survival. For this purpose, we compared survival between patients showing a reduction of BE by ≥40 or 50% at follow-up (mean change) and patients showing no or smaller changes. In patients with BE ≥10 mmol·L⁻¹, the reduction of BE after the start of NPPV was clearly associated with an improved long-term survival. However, as the analysis comprised a number of patients with exacerbation, the reduction of PaCO₂ or BE could not be attributed to NPPV alone. Irrespective of this, our data indicate that BE might be helpful not only for the prediction but also for the assessment of benefits from interventions, such as NPPV.

THE IMPACT OF MY WORK ON CLINICAL OR RESEARCH PRACTICE

In summary, we concluded that BE, an easily obtainable measure, is of value in the assessment of both mortality risk and treatment efficiency in patients with COPD and CHRF.

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