

## Output of the Wright jet nebulizer

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We read with interest the recent paper by Kongerud, Soyseth and Johansen [1].

They found that at constant pressure and flow rate the output, defined as mass loss per minute, of a Wright nebuliser varies with ambient temperature. In a recent paper we described the results of investigations which bear on this problem [2]. A progressive drop in temperature of the vial content and a progressive reduction in the rate of overall output are reported, as is a progressive concentration of the solute in the liquid remaining in the vial. It is clear that during the process of nebulisation liquid is lost from the vial both by droplet formation and by evaporative loss. In our investigations about three quarters of the total loss was a result of evaporation. As evaporative loss would be much greater if the solute temperature was higher at the start of nebulisation it seems

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inevitable that total weight loss in the first two minutes must be higher also, even if the portion put out as droplets were constant.

The reduction in overall output when a nebuliser is run at a lower temperature may be partly compensated by increased ratio of true droplet to total output and must also be partly compensated during the nebulisation by the progressive increase in the solute concentration consequent upon the evaporative loss.

### References

1. Kongerud J, Soyseth V, Johansen B. – Room temperature influences output from the Wright jet nebulizer. *Eur Respir J*, 1989, 2, 681–684.
2. Cockcroft DW, Hurst TS, Gore BP. – Importance of evaporative water losses during standardised nebulised inhalation challenge tests. *Chest*, 1989, 96, 505–508.

## Room temperature and output of a jet nebulizer

D. Köhler, D. Hochrainer

Dear Sir,

The quality of the Journal is a good as the reviewers. They must be familiar with the problem and be able to detect principle errors. The paper from Kongerud *et al.* [1] gives an example of the insufficiency of this procedure which may occur occasionally, especially if problems of physics are treated in medical journals.

The authors have problems to explain the dependency of the output of a jet nebulizer (expressed as weight lost) on the room temperature. They mentioned "The physical basis for the effect of room temperature on solute output is unclear". Normally an enthusiastic scientist would not publish a paper until the obvious problem has been solved.

The solution is very simple: weight loss of a nebulizer is partly caused by the aerosol and partly by evaporation of water. The latter can be easily calculated and depends only on the room temperature. Since the air was taken from a compressed air cylinder it was absolutely dry. In

the nebulizer and air becomes almost saturated with water vapor. The saturated concentration at 19°C is 16.323 mg·l<sup>-1</sup> and at 24°C, 21.81 mg·l<sup>-1</sup> [2]. The increase from 19°C to 24°C entails an increase in absolute humidity of 5.49 mg·l<sup>-1</sup> or

$$(21.81-16.32)/21.81=0.25=25\%$$

This explains the measured increase of the output of approximately 23% very well. The example shows remarkably that the estimation of the inhaled aerosol dose from the weight loss of the nebulizer (not rarely used in provocation test) is nonsense.

### References

1. Kongerud J, Soyseth V, Johansen B. – Room temperature influences output from the Wright jet nebulizer. *Eur Respir J*, 1989, 2, 681–684.
2. Kohlrausch F, - Praktische Physik III, Tafeln. *Taubner Stuttgart*, 1968.

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J. Kongerud, V. Søyseth, B. Johansen

Dear Sir,

We appreciate the comments from Køhler and Hochrainer on our paper regarding room temperature and its influence on nebulizer output [1]. We agree that increased evaporation at higher temperature might partly explain the increased output. This is also suggested by COCKROFT *et al.* [2]. We are still not convinced, however, that a difference in room temperature of 5°C would be accompanied by the same temperature difference in the vial during the whole nebulization period. If not, the proposal of Køhler and Hochrainer could not fully explain our results. Furthermore, they have in their mathematical example used 21.81 as the denominator instead of 16.32. When the latter is used, the estimated increase is 34%.

Nevertheless, the main point of our paper was to focus on improved standardization of non-specific bronchial challenge. We need simple calibration methods to standardize the dose deposited in the airways. The SEPCR Working Group "Bronchial Hyperreactivity" has recommended that the output from the nebulizer should be measured by weighing the nebulizer before and after use for a set time to calculate the actual dose of

bronchoconstrictor given [3]. However, standardized environmental conditions should also be applied. Until better ways of determining the output have been agreed upon, estimation of inhaled aerosol dose based upon weight loss is an accepted and fairly simple method. Only further studies will show whether this is nonsense or not.

#### References

1. Kongerud J, Søyseth V, Johansen B. – Room temperature influences output from the Wright jet nebulizer. *Eur Respir J*, 1989, 2, 681–684.
2. Cockcroft DW, Hurst TS, Gore BP. – Importance of evaporative water losses during standardized nebulized inhalation provocation tests. *Chest*, 1989, 96, 505–508.
3. Eiser NM, Kerrebijn KF, Quanjer PH eds. – SEPCR Working Group "Bronchial Hyperreactivity". Guidelines for standardization of bronchial challenge with (nonspecific) bronchconstricting agents. *Bull Eur Physiopathol Respir*, 1983, 19, 495–514.

## Corrigendum

**Phagocyte enzymes in bronchoalveolar lavage from patients with pulmonary sarcoidosis and collagen vascular disorders.** Y. Sibille, J.B. Marinot, L.L. Polomski, B. Wallaert, M. Demusis, J.A. Rankin, C. Voisin, J.G.L. Gee. *Eur Respir J.*, 1990, 3, 249–256. Figures 3 and 4 were inadvertently transposed during preparation. They should be reversed for correct order to match the legends.