COMPARISON OF MESH NEBULISER VERSUS JET NEBULISER IN SIMULATED ADULTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Hickin, S[1], MacLoughlin, R[2], Sweeney, L[3] Tatham, A[4] and Gidwani, S[5]

1. Core trainee year 2, MBBS Bsc - Chelsea and Westminster NHS Trust, London, UK; 2. Senior scientist PhD - Aerogen Ltd, Galway, Ireland; 3. Scientist – Aerogen Ltd, Galway, Ireland; 4. Scientist PhD – Aerogen Ltd, Galway, Ireland; 5. Emergency Medicine Consultant MBBS FCEM – Chelsea and Westminster NHS Trust, London, UK

Introduction:

Chronic Obstructive Pulmonary Disease (COPD) is an increasingly large burden on Emergency Departments[1]. The mainstay of treatment during an exacerbation is beta-agonist and anti-cholinergic therapy using a jet nebuliser and a standard face mask, as well as steroids and antibiotics[2]. The response to bronchodilators is dose dependent so using the most efficient device to deliver the drug is vital.

The jet nebuliser is the gold standard method of drug delivery and previous trials have looked at spacers and hoods but are yet to show a significant improvement in drug deposition and clinical signs in adults.

The Aerogen Solo® is an electronically driven aerosol generator that utilizes a vibrating mesh, where energy applied to the vibrational element causes vibration of each of the 1000 apertures within the mesh drawing liquid through the holes. The Aerogen Solo® Adapter acts as a holding chamber and also allows administration of low flow oxygen during administration.

The aim of this study is to compare the dose and rate of drug delivery of a new mesh nebuliser (MN) with the current standard jet nebuliser fitted to a standard face mask in a breathing model simulating a normal patient and one having a COPD exacerbation.

Method:

The study involved a lung model which consisted of a teaching mannequin connected to a sinusoidal pump via a collecting filter **(Figure 1 and 2)** at the level of the carina (Ingmar ASL 5000). This simulated a spontaneously breathing adult with the respiratory pattern seen in a normal patient (respiratory rate 15, tidal volume 590mls, inspiratory:expiratory ratio 1:1) and one with an acute exacerbation of COPD (respiratory rate 30, tidal volume 265ml, inspiratory:expiratory ratio 1:3).

2ml of salbutamol 2mg/ml was aerosolised with either a standard JN using a face mask (Aquineb ®) or a MN (Aerogen Solo®) with an Adapter (Aerogen Solo® Adapter) attached to a valved facemask[3]. Both were operated with air at the rate stated by the manufacturer (2L/min for MN and 5L/min for JN). To replicate the seal achieved when a patient uses a mask, both masks were taped to the mannequin to avoid leak.

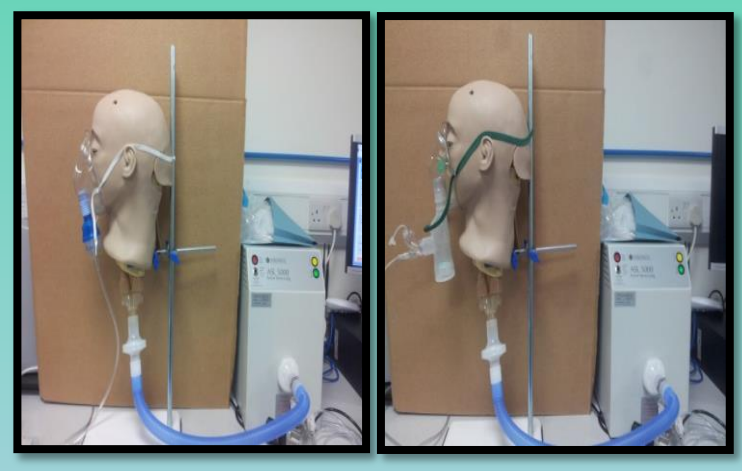


Figure 1 (left) – lung model with jet nebuliser. Figure 2 (right) – lung model with mesh nebuliser

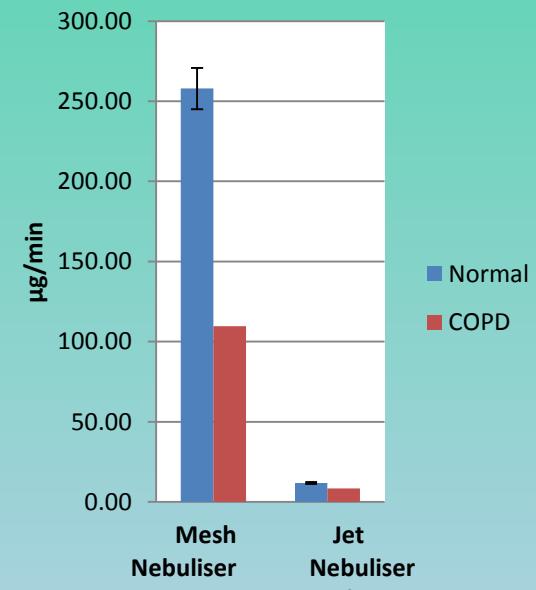
Aerosol drug delivered to an absolute filter (Respirgard 303) at the end of the mannequin's trachea was mixed with an ethanol/water buffer and measured using a spectrophotometer to quantify the amount of drug delivered. The total treatment time was recorded with a stopwatch. The experiment was repeated 3 times (n=3) for each nebuliser using the normal and then the COPD setting.

The data was then analysed using a two-sample unequal variance T-test performed in Microsoft Excel ®.

Results:

	MN (normal)	JN (normal)	P value	MN (COPD)	JN (COPD)	P value
Nebulisation time (mins and secs)	4 mins 30 secs +/-3 secs	6 mins and 41 secs +/-29 secs	**0.015**	4 mins 38 secs +/- 16 secs	8 mins 50 secs +/- 52 secs	**0.016**
Respirable dose (% of total dose)	**29.0 +/-4.2**	**2.0 +/- 0.5**	**0.007**	**12.6 +/- 0.8**	**1.6 +/- 0.1**	**0.001**
Residual mass (% of total)	0.7 +/- 0.3	40.6 +/- 1.0	**<0.001**	0.9 +/- 0.2	42.9 +/- 0.5	**<0.001**
Dose rate (µg/min)	**257.9 +/- 39.1**	**11.9 +/- 3.0**	**0.008**	**109.7 +/-13.8**	**8.4 +/- 1.2**	**0.005**

Table 1: Results of variables measured for MN and JN using a normal and a COPD model



Graph 1: Demonstrating rate of drug delivery in MN cf. JN in normal and COPD models

Conclusions:

Our lab-based study has shown that a mesh nebuliser is quicker and more effective than a jet nebuliser, delivering more salbutamol over a shorter period of time. We have also shown that over the duration of the nebuliser treatment, the mesh nebuliser delivers nearly 8 times the dose of salbutamol to the carina compared with the jet nebuliser. This could have significant implications for patient care.

This is part of an ongoing project to compare mesh and jet nebulisers. We will shortly be commencing a randomised controlled trial to compare these nebulisers in patients presenting to the Emergency Department with acute COPD. This promising data from the lab study has supported our hypothesis that a mesh nebuliser is a more effective method of delivering inhaled bronchodilators to patients with respiratory disease.

References

1. http://www.patient.co.uk/health/chronic-obstructive-pulmonary-disease-leaflet
2. http://guidance.nice.org.uk/CG101
3. Ari A, Dornelas de Andrade AF, Sheard M, Fink J. Performance comparisons of jet and mesh nebulizers with mouthpiece, aerosol mask and valved mask in simulated spontaneously breathing adults. *Presentation Abstract at the American College of Chest Physicians* 2014

Acknowledgements:

This study was funded by Aerogen Ltd, Galway, Ireland