Effect of Bronchodilator Salbutamol Therapy Administered by Metered Dose Inhaler (MDI) Versus Jet Nebulizer in Bronchial Asthma

Ali Hussain, FCPS, MD[1], **Md. Rashidul Hassan**, FCPS, MD[2], **Md. Khurshidul Islam**, DTCD[3], **Mohammad Enamul Haque**, DTCD[4], **Mizanur Rahman**, MBBS[5], **A.K.M. Moslehuddin**, FCPS[6]

Summary :

Bronchodilator efficacy of salbutamol aerosol therapy delivered either by metered dose inhaler (MDI) or by jet nebulizer compared in 13 patients with stable chronic bronchial asthma. Peak expiratory flow (PEF), Forced expiratory volume in one second (FEV_1), Forced vital capacity (FVC) were monitored before and after therapy for one hour. PEF increased from a baseline 194 L to 239 L at one hour after jet nebulizer and increased from 194 L to 236 L after MDI therapy. FEV increased from a baseline mean of 0.83 L to 1.59 L at one hour after jet nebulizer therapy and increased from 0.85 L to 1.54 L after canister (MDI) therapy. FVC also increased similarly after each form of therapy. The two types of aerosol therapy were equally effective and were without side effects. There was no significant difference of change in pulmonary function between two delivery methods. MDI therapy has the advantage over jet nebulizer therapy by being convenient and cheaper.

Introduction :

Aerosol bronchodilators are important therapy for patients with asthma. Aerosol therapy is well accepted by patients and physicians, because it is effective, it has a rapid onset of action, and it is usually free of side effects. Bronchodilator aerosol can be generated from a canister (MDI) or jet nebulizer. Although MDI are widely used by the out patients, physician and patients often resort to jet nebulizer for bronchodilator therapy in hospital and sometimes at home. Numerous studies have demonstrated that bronchodilator efficacy is similar whether the aerosol is inhaled from MDI or from nebulizer particularly in asthma[1-4].

However in asthmatic patients with severe airflow obstruction, some studies have demonstrated that aerosol therapy from a nebulizer is more effective than from MDI[5-8]. The twomodes of therapy have quite different doses of medication, duration of therapy and inhalation technique.

The doses of medication for nebulizer therapy is usually extended over 5 to 20 minute with nebulizer, whereas it is less than a minute with MDI. With jet nebulizer the patient is usually asked to breath through open mouth with an occasional deep breath. With MDI the patient is asked to synchronize the actuation of canister and inhalation by mouth to inhale slowly and deeply and then to breath hold for a few seconds before resuming normal respiration. This study was designed so that the duration of aerosal therapy was the same for the two modes of therapy in patients with asthma.

1. Assistant Professor, IDCH, 2. Asstt. Professor, IDCH, 3. Asstt. Professor, IDCH,
4. Junior Consultant, IDCH, 5. Medical Officer IDCH, 6. Director-cum Professor, IDCH.

Materials and Methods :

13 asthmatic patients in stable condition were studied. The diagnosis of asthma was on the basis of reversible airflow obstruction and of with marked variation both of airflow obstruction and of clinical symptoms in the absence of other lung disease. The study was approved by the authority and patients gave their written consent.

The study comprised of two consecutive 4 days period after assessment. Patients admitted in IDCH were included in the study. All patients withhold bronchodilator therapy overnight. In the morning the baseline pulmonary functions was tested. Then each patient was treated with salbutamol 2.5 mg (2.5 ml) diluted to 4 ml with 0.9% saline solution administered from the nebulizer driven by an air compressor at aflow rate of 7L/minute[9]. All patients used a face mask and were instructed to breath tidally. Nebulization was continued to the end of visible aerosol production (13 to 15 minutes). While the solution was nebulized, the nebulizer unit was sharply tapped occasionally so that the drops of solution adhering to the wall of nebulizer would drip down to be nebulizer untill there was no aerosol generated. Each day such aerosol from nebulizer was given 4 times. Pulmonary function was tested at 10,30 and 60 minutes after therapy. The higher of the duplicate measurement of FEV_1 and FVC was selected for statistical analysis. Blood pressure and pulse rate were measured and side effects was questioned just before each pulmonary function test. The same procedure was applied for the first 4 days patients were demonstrated proper inhalation technique before entering the study. One puff (100 μgm) of aerosol, self actuated was inhaled slowly and deeply over 2 to 3 seconds starting from functional residual capacity and followed by a 10 seconds breath hold before exhalation and resumption of normal respiration. After one minute interval a second puff was inhaled. The same process was applied 4 times daily. Pulmonary function was tested at 10,30 and 60 minute after inhalation. The higher of duplicate measurement of FEV_1 and FVC was selected for statistical analysis. Fishers exact probability test was applied and P value less than 0.05 was taken as significant.

The patients were randomly allocated to one of the two treatment regimens, so that they inhaled either salbutamol nebulizer or salbutamol MDI from canister for the first 4 days. The next 4 days trial was with either of the two which was not used in the first 4 days period.

Results :

All patients verbally reported an improvement in their symptoms during the study period and attributed this to the nebulizer but analysis of the visual analogue and symptoms scores for breathlessness showed no significant difference between the nebulizer and MDI. The symptom scores for cough was similarly uninfluenced by either method. PEF was not correlated with visual analogue score for breathlessness.

Table - I Shows the mean value and range of different pulmonary functions before starting trial. PEF was found to be 194±16.8 FEV_1 was 0.83 ± 0.12 and FVC 1.20 ± 0.15 respectively.

Table-II : Shows the mean value of PEF at 10,30 & 60 minutes following nebulizer and MDI. The changes in PEF on nebulized salbutamol and MDI was not statistically significant when compared (P value >0.05).

Table -I

Pulmonary Functions	Mean ± SE	Range
Peak expiratory flow (PEF)	194±16.8	180-205
Forced expiratory volume in one second (FEV1)	0.83±0.12	0.52-1.0
Forced vital capacity (FVC)	1.20±0.15	0.85-1.30

Shows the pulmonary function before starting trial. (n=13)

Table-II

Time	Nebulizer	MDI	P-value
10 minutes	224±16.6	221±18.4	>0.05
30 minutes	245±19.9	241±20.0	
60 minutes	239±18.8	236±20.1	

Shows the mean value of PEF with nebulizer and MDI. (n = 13)

Table - III shows the mean value of FEV1 at 10,30 & 60 minutes interval with jet nebulizer versus MDI. The pretreatment FEV1 was 0.83L.

After nebulizer FEV_1 increased to 1.43, 1.53, 1.59 at 10.30 & 60 minute and with MDI it increased to 1.40 1.51 & 1.54 respectively. The bronchodilator response was remarkably similar with the two modes of therapy. There was no significant difference between two modes (P>0.05)

Table-III

Time	Nebulizer	MDI	P-value
10 minutes	1.43±0.18	1.40±0.15	>0.05
30 minutes	1.53±0.16	1.50±0.18	
60 minutes	1.59 ± 0.15	1.54±0.15	

Shows the mean value of FEV1 with nebulizer and MDI. (n = 13)

Table - IV shows changes in FVC The pretreatment FVC was 1.02 Following nebulizer it increased to 1.51, 1.58 & 1.62 at 10,30 & 60 minute interval. With MDI it increased to 1.49, 1.55 & 1.60 with same interval. Though following nebulizer the FVC increased to MDI statistically it was not significant. None of the patient complaint of any side effects during the study.

Table-IV

Time	Nebulizer	MDI	P- value
10 minutes	1.51 ±0.12	1.49 ±0.16	>0.05
30 minutes	1.58 ±0.13	1.55 ±0.14	
60 minutes	1.62 ±0.18	1.60 ±0.19	

Shows the mean value of FVC with nebulizer and MDI. (n=13)

Discussion :

Inspite of the relatively large dose that is dispensed in the usual jet nebulizer therapy, the dose actually nebulized during inspiration is small. The dose of salbutamol dispensed for routine jet nebulizer therapy is 2.5 mg is equivalent to 12 puffs of metered dose aerosol from a canister. Less than 20% of the dose is nebulized during inspiration & only 10% of the nebulized dose is expected to enter the tracheobronchial tree to effect bronchodilatation. The largest source of the waste is the residual solution in nebulizer. The residual solution found in one study ranged 0.9 ml to 1.2 ml and only 53-63% is nebulized. The second major source of waste is continuous nebulization during expiration. Since the volume of residual solution should be relatively constant, increasing the volume of diluent should increase the fraction of solution nebulized. By use of T-shaped piece in the air hose to the nebulizer and occluding the side arm intermittently during inspiration, one can eliminate the waste of aerosol during the expiration phase.

The two puffs of salbutamol aerosol admin stered from MDI with a breath hold for 10 seconds and a gap of one minute between the puffs will allow the first puff to partially dilate the bronchial tree, which will allow deeper penetration of subsequent puffs of aerosol. Our patient had good inhalation technique for aerosol therapy from a MDI. Both the above factors may influence the results when compared with jet nebulizer.

There are advantage of jet nebulizer therapy. It does not require learning aerosol inhalation technique as is necessary with MDI. Jet nebulizer therapy formalizes the treatment regimens for the patient, so that inhalation therapy is not as casual as when MDI are used. Such formalization may induce better patients compliance and patient may even benefit from psychologic stand point. Jet nebulizer therapy is often perceived as a more intensive form of respiratory therapy by the patient. This notion probably stems from the common practice of the use of jet nebulizer for patient who are hospitalized or in the emergency room. These potential benefits should be balanced against the facts that the jet nebulizer is not portable, it is more expensive to purchase the equipment and the medication and it requires meticulous cleaning daily. Nebulizer can be a source of nosocomial infection unless a cleaning procedure is strictly adhered to. On the other hand MDI is cheaper and only it requires proper technique of inhalation. There is no advantage of nebulizer over MDI when responses compared. The two forms of therapy are equally effective and usually without side effects.

Acknowledgement :

The authors wish to thank all the stuff of asthma centre IDCH, Mohakhali, Dhaka for supplying the nebulizer and MDI. Our thanks are also to patients who allowed to perform the study.

References :

1. Christensson P, Arborelius M Jr. Lilja B; Salbutamol inhalation in chronic asthma bronchiale; dose aerosal vs jet nebulizer. Chest 1981; 79 : 416.
2. Anderson PB, Goude A Peake MD; Comparison of salbutamol given by intermittent positive pressure breathing and pressure-packed aerosol in chronic asthma; Thorax 1982. 97 : 612.
3. Taylor WF. Heimlich EM. Strick L. Busser RJ. Intermittent positive pressure breathing versus Freon-Unit nebulized isoproterenol in asthmatic children J Allergy 1966; 38 : 257.
4. Cayton RM, Webber B, Paterson JW, Clark TJH; A comparison of salbutamol given by

pressure packed aerosol or nebulization via IPPB in acute asthma Br. J Dis Chest 1978; 72 : 222.

5. Berend N, Webster J, Marlin GE; Salbutamol by pressure packed aerosol and by intermittent positive pressure ventilation in chronic bronchitis. Br. J Dis Chest 1978; 72 : 222.
6. Wilson RSE Connelon SJ, Domicillary nebulized salbutamil solution in severe chronic airway obstruction. Thorax 1980; 35 : 873.
7. Connelon SJ, Wilson RSE. The use of domicillary nebulized salbutamol in the treatment of severe emphysema. Br. J Clin Prac. 1979; 33 : 135.
8. Choo-kong Y, Grant IWB. Comparison of two methods of administering bronchodilator aerosol to asthmatic patients. Br. Med. J 1975; 2 : 119.
9. Clay MM, Pavia D, Newman SP, Clark SW, Assessment of jet nebulizer for lung aerosol therapy. Lancet 1983; 2 : 592.s
10. McGivern DV, Ward M, Revill S, Sechiara A Mac Farlen J, Davies D. Home nebulizers in severe chronic asthma. Br. J Dis Chest 1984; 78 : 376
11. Newman SP, Pa via D, Moren F, Clark SW. Deposition of pressurized aerosols in the human respiratory tract. Thorax 1981; 36 : 52.
12. Davies DS; Pharmacokinetics of inhaled substances Scand J Respir Dis 1979; 103 : 44.
13. Heimer D, Shim C, Willia Ms Jr MH. The effect of sequential inhalation of metaproterenol aerosol in asthma. J Allergy clin Immunol 1980; 66 : 75.
14. Susan C,. Jenkins MCSP, Richard W, Healon MD; Comparison of nebulized salbutamol and salbutamol from a metered dose inhaler in stable chronic airflow limitation. Chest; 1987; 19/6 : 805.