

## The effectiveness of modified air pressure pump for nebulizer in children with acute asthmatic attack.

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Chumdermpadetsuk S, Ngampaiboon J, Loahakunakorn S, Prapphal N, Limudomporn S, Boonpirak B. The effectiveness of modified air pressure pump for nebulizer in children with acute asthmatic attack. *Chula Med J* 1988 Oct; 32(10) : 927 - 932

*Car tyre air pressure pump was connected to household electrical outlet and nebulizer to generate mist particles delivering salbutamol respiratory solution 0.02 ml/kg, single dose to pediatric patients with acute asthmatic attack. The respiratory rate significantly decreased after the inhalation. The average increase in PEFV was 24.7% (p value = 0.001) and wheezing disappeared in 7/10 cases. The price of the machine was 1,000 bahts as compared to 4,000-10,000 of the imported air compressor. Further modification for lesser noise and more compact model is recommended.*

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Received for publication. May 15, 1988.

เสาวนีย์ จำเดิมแผด็จศึก, จรุงจิตร งามไพบุลอย, สิริยาภรณ์ เลาหคุณากร, นวดจันทร์ ปราบพาด, สุภัทรา ลิมุดุมพร, บุญเนา บุญภิรักษ์. การใช้เครื่องสูบยางรถยนต์ดัดแปลง เพื่อพ่นยาขยายหลอดลมในเด็กจับหืด.  
จุฬาลงกรณ์เวชสาร 2531 ตุลาคม : 32 (10) : 927-932

การรักษาผู้ป่วยหอบหืดด้วยการพ่นยาขยายหลอดลม โดยเครื่องพ่นฝอยละอองพบว่ามีประสิทธิภาพดี  
ในเด็ก ขณะนี้เครื่องอัดอากาศชนิดกระเป๋าทวีที่ใช้ในการพ่นจำเป็นต้องสั่งจากต่างประเทศ ดังนั้นปัญหาเรื่อง  
ราคาจึงเป็นอุปสรรคสำคัญสำหรับภาวะเศรษฐกิจในประเทศไทย ได้ทำการทดลองทางคลินิกในผู้ป่วยเด็กขณะ  
หอบหืด 10 ราย โดยการประยุกต์นำเครื่องสูบยางรถยนต์ซึ่งมีราคาถูกมาใช้ร่วมกับ Salbutamol respiratory  
solution พบว่าได้ผลดีสามารถลดอัตราการหายใจเสียงหวีดในปอด และเพิ่ม PEF (peak expiratory flow  
rate) อย่างมีนัยสำคัญทางสถิติ สามารถนำไปใช้โดยผู้ป่วยที่บ้านเพื่อรักษาอาการหอบหืดได้  
แต่ควรปรับปรุงเครื่องนี้ให้มีเสียงรบกวนน้อยลง และรูปร่างกระทัดรัดขึ้น

Nebulizer containing B<sub>2</sub> agonist aerosol when connected to portable air compressor has been used successfully in pediatric patients with acute asthmatic attack. (1-4) There are several models of such instruments (5-6) but they are expensive, making the home use almost unaffordable for present Thai socioeconomic status. Therefore we have adapted the car tyre air pump to generate the required air flow for the nebulizer, to be used in acute asthmatic attack in children.

### Material and method

Portable car tyre air pump was connected to an AC to DC the adapter to generate air pressure by using the regular household electrical outlet. (Figure 1). The pump was then connected to a small volume medication nebulizer which produced water particles 1-5  $\mu$  in size that would reach small airways (4,5) and alveoli.

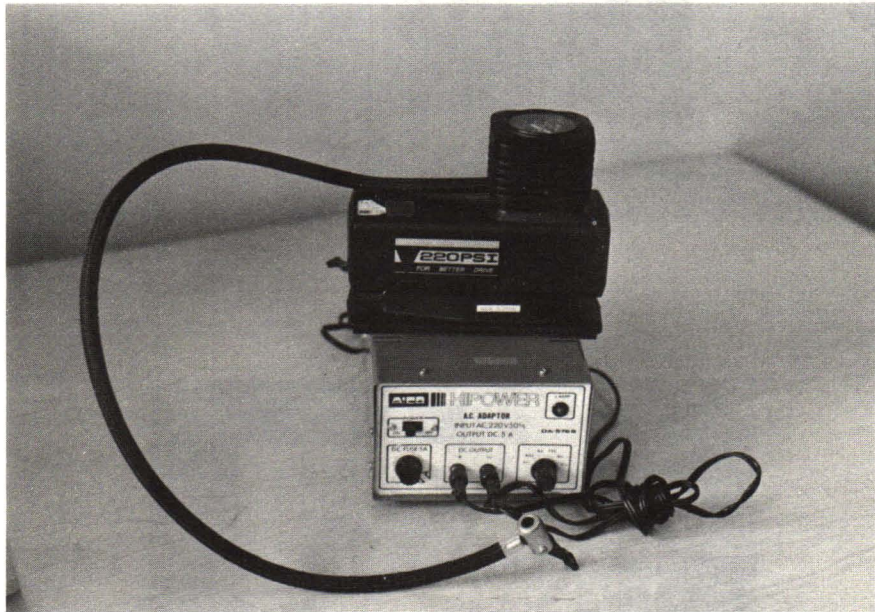
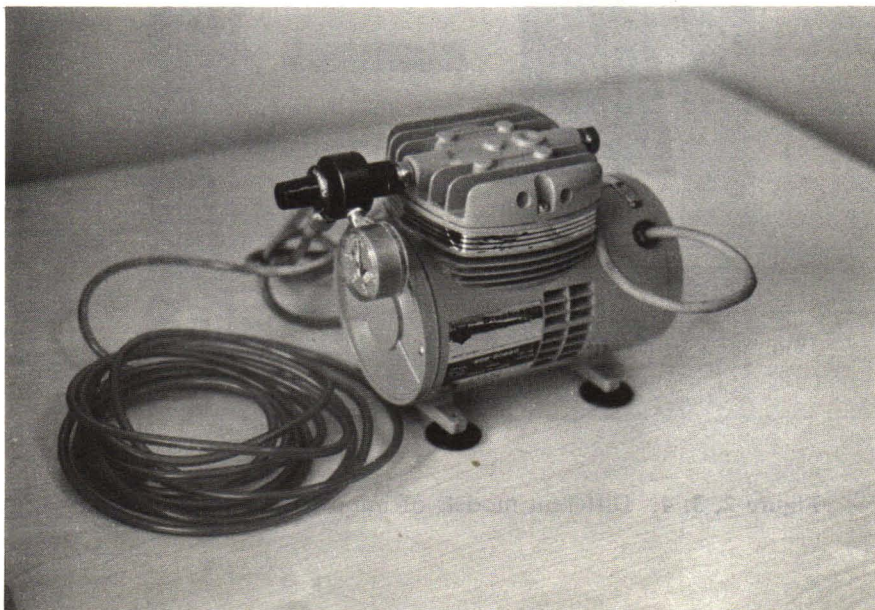


Figure 1. Air car type pump and AC adapter.

Three other types of portable air compressors were connected to the same model nebulizers.\* (Figure 2,3,4)



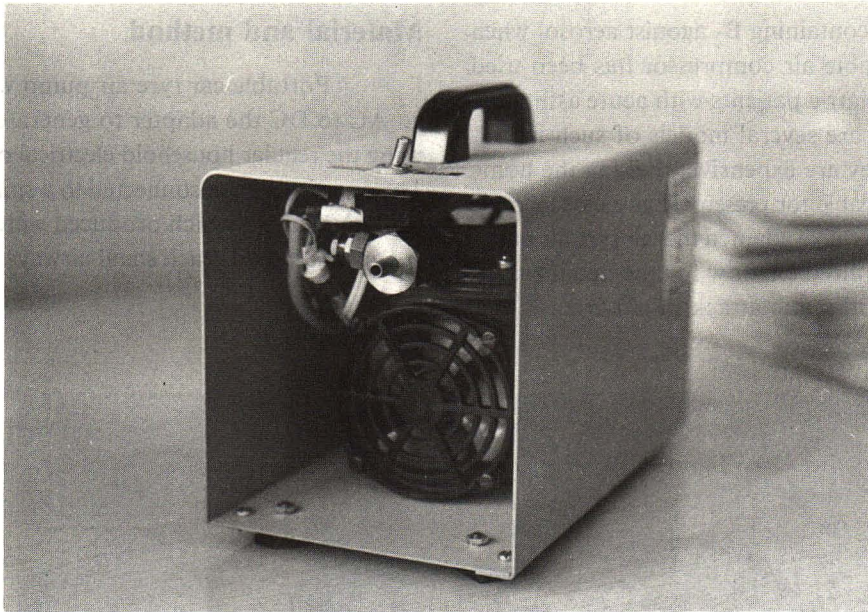


Figure 2, 3, 4. Different models of imposed air compressors.

The air and mist generated by each machine were measured for

1. air flow
2. sterility of the mists
3. lubricating oil

1. Diaphragm compressor 999\* 20888 C; Bird Corporation, USA.

2. Ventolin Nebulising unit MK 6 Model 6026, A > R > Harris Company Limited; Newzealand.

3. EROSA 100 Aerosol therapie-Gerat, GmbH fur Medizintechnik, West Germany.

## Results

The air flow generated by each air pump was over 20 Litres per minute. The cultures of mists by aerobic and anaerobic methods were all negative. The tests for lubricating oil were negative when the pressured air from all air pumps were collected under 500 ml of sterile water.

The adapted air pressure pump was used in 10 children in acute asthmatic attack with nebulized salbutamol respiratory solution 0.02 ml/kg/dose (single dose). The results were summarized in Table 1

**Table 1** Data of the patients before and after nebulizer.

Patient no.	Age (yr)	Sex	BW (kg)	Ht (cm)	Lung signs		PR		RR		PEFR	
					pre	post	pre	post	pre	post	pre	post
1	4 6/12	M	16	105	exp wheezing	↓wheezing	120	132	32	28	80	102
2	7	F	18	117	exp wheezing	no	120	130	36	28	106	118**
3	13	M	27	137	exp wheezing	no	120	116	24	18	107	152
4	9	M	23.5	126.5	exp wheezing	no	100	100	24	20	145	170**
5	7	M	23	120	exp wheezing	no	96	104	28	24	80	100
6	12	M	26.5	132	exp wheezing	no	100	100	36	24	160	220
7	5 5/12	M	15	104	exp wheezing	no	108	116	32	20	105	130
8	7	M	22.5	122	exp wheezing	wheezing	100	104	32	32	160	170**
9	11	F	37	135	exp wheezing	no	80	76	24	22	130	200
10	10	M	22	-	exp wheezing	↓wheezing	140	120	44	40	138	148**

\*\*PEFR increased less than 20%

Lung signs after treatment improved in all patients, Wheezing completely disappeared in 7 children. Pulse rate before and after treatment were not statistically different ( $p = 0.8$ ) Respiratory rate after treat-

ment decreased with statistical significance ( $p = 0.001$ ). PEFR after treatment increased significantly ( $p = 0.001$ ) and average increase in PEFR was 24.7% (Table 2)

**Table 2** Mean PR, RR and PEFR before and after nebulizer.

	pre Rx	post Rx	P value
PR	109.2 + 16	109.8 + 16	0.8
RR	31.2 + 6.4	25.6 + 6.6	0.001
PEFR	121.1 + 29.8	151.0 + 40.0	0.001

## Discussion

Imported portable air compressors are expensive ; ranging from 4,000 - 10,000 bahts. The adapted air compressor costs only 1,000 bahts. The clinical trial with salbutamol (0.02 ml/kg/dose) showed significant improvement of respiratory rate, lung signs and PEFr.

There were 2 cases (no 8 and 10) in which that respiratory rate and PEFr did not significantly change. This may reflect the non responder to inhaled aerosol at the usual dose, or concurrent bronchitis. In case No.2 & 4 respiration decreased significantly with lung signs and objective-subjective improvements but PEFr increased only 11% & 17% respectively. In the hospital setting, pressured oxygen is preferred to air compressor in case with hypoxemia, but at home where the oxygen tank is expensive and difficult to store due to its space

occupying and safety requirements, the portable air compressor is preferred. The adapted unit had the disadvantage of the noisier air pump machine when compared with the ready-made commercial models, but the price is more suitable for most patient's socioeconomic status. These drawbacks can be solved by mechanical modification. The patients and their parents can be instructed to operate this simple machine themselves when indicated, and therefore hospital visits due to acute asthma can decrease.

## Acknowledgement

The authors gratefully acknowledge the assistance of Ms. Orana Chaivorarat from Division of Food Analysis, Department of Medical Science in analysis of lubricating oil.

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