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

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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 PEFR 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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การรักษาผู้ป่วยหนักที่มีภาวะการขับอากาศขัดข้อง โดยเรียงลำดับอาการของผู้ป่วยมีประสิทธิภาพคือ

ในครั้ง ขณะนี้เครื่องสกัดอากาศชนิดการเป่าหัวที่ใช้ในการรักษาเป็นต้องมาจากทางประเทศ ดังนั้นปัญหาเรื่อง
ราคาจึงเป็นอุปสรรคสำคัญสำหรับการประชุมทางระบบในประเทศไทย ให้ทำภาพทดสอบทางอินิกในผู้ป่วยคงชำ
ลงที 10 ราย โดยการประชุมทั้งหมดเครื่องสกัดอากาศที่มีราคาทุกตัวไม่เกิน Salbutamol respiratory
solution พบว่า ได้ผลที่สามารถลดอาการหายใจได้หลังรักษาในปอด และเพิ่ม PEFR (peak expiratory flow
rate) อย่างมีนัยสำคัญทางสถิติ สามารถนำไปใช้โดยผู้ป่วยในปัจจุบันเพื่อรักษาอาการขัดข้องได้

แพทย์รับปรุงรักษาได้ที่มีผลสอดคล้องและความปลอดภัย ระหว่างการรักษาค่ะ
Nebulizer containing $B_2$ 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 μ in size that would reach small airways ($4,5$) and alveoli.

![Figure 1. Air car type pump and AC adapter.](image)

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.

Table 1 Data of the patients before and after nebulizer.

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age (yr)</th>
<th>Sex</th>
<th>BW (kg)</th>
<th>Ht (cm)</th>
<th>Lung signs</th>
<th>PR pre</th>
<th>PR post</th>
<th>RR pre</th>
<th>RR post</th>
<th>PEFR pre</th>
<th>PEFR post</th>
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<tbody>
<tr>
<td>1</td>
<td>4/6/12</td>
<td>M</td>
<td>16</td>
<td>105</td>
<td>exp wheezing</td>
<td>120</td>
<td>132</td>
<td>32</td>
<td>28</td>
<td>80</td>
<td>102</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>F</td>
<td>18</td>
<td>117</td>
<td>exp wheezing</td>
<td>120</td>
<td>130</td>
<td>36</td>
<td>28</td>
<td>106</td>
<td>118**</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>M</td>
<td>27</td>
<td>137</td>
<td>exp wheezing</td>
<td>120</td>
<td>116</td>
<td>24</td>
<td>18</td>
<td>107</td>
<td>152</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>M</td>
<td>31.6</td>
<td>132.5</td>
<td>exp wheezing</td>
<td>100</td>
<td>100</td>
<td>28</td>
<td>24</td>
<td>145</td>
<td>170**</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>M</td>
<td>23</td>
<td>70</td>
<td>exp wheezing</td>
<td>100</td>
<td>100</td>
<td>36</td>
<td>24</td>
<td>160</td>
<td>220</td>
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<tr>
<td>6</td>
<td>12</td>
<td>M</td>
<td>37</td>
<td>132</td>
<td>exp wheezing</td>
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<td>100</td>
<td>36</td>
<td>24</td>
<td>160</td>
<td>220</td>
</tr>
<tr>
<td>7</td>
<td>5/12</td>
<td>M</td>
<td>15</td>
<td>104</td>
<td>exp wheezing</td>
<td>108</td>
<td>116</td>
<td>32</td>
<td>20</td>
<td>105</td>
<td>130</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>M</td>
<td>22.5</td>
<td>122</td>
<td>exp wheezing</td>
<td>100</td>
<td>104</td>
<td>32</td>
<td>32</td>
<td>160</td>
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<tr>
<td>9</td>
<td>11</td>
<td>F</td>
<td>37</td>
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<td>10</td>
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<td>M</td>
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<td>140</td>
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<td>44</td>
<td>40</td>
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<td>148**</td>
</tr>
</tbody>
</table>

**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 treatment 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.

<table>
<thead>
<tr>
<th></th>
<th>pre Rx</th>
<th>post Rx</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR</td>
<td>109.2 + 16</td>
<td>109.8 + 16</td>
<td>0.8</td>
</tr>
<tr>
<td>RR</td>
<td>31.2 + 6.4</td>
<td>25.6 + 6.6</td>
<td>0.001</td>
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<tr>
<td>PEFR</td>
<td>121.1 + 29.8</td>
<td>151.0 + 40.0</td>
<td>0.001</td>
</tr>
</tbody>
</table>
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

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References