A Patient’s Perspective on Nebulizers

An overview of the pros and cons of the different Nebulizers

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PAP Patient Education Day
Nebulizers

- I am not endorsing or recommending any specific brand, product, or device. I am simply reviewing some of the products available and what some of the pros and cons are for each type of equipment or device.

- You should consult your doctor, health insurance, fellow patients, and your “pocketbook”, as to what nebulizer is best for you.
Nebulizers

What is a Nebulizer?

It is a drug delivery device used to administer medication in the form of a mist inhaled into the lungs. It converts a liquid, or semi-liquid, medication into an aerosol that can be inhaled into the lungs.
Nebulizers

- Jet, Ultrasonic, and Mesh Nebulizers: An Evaluation of Nebulizers for Better Clinical Outcomes, Arzu Ari, Georgia State University, aari1@gsu.edu, 2014

- Delivery Efficacy of a Vibrating Mesh Nebulizer and a Jet Nebulizer under Different Configurations, Laurent Pitance, Laurent Vecellio, Teresinha Leal, Gregory Reychler, Herve Reychler, and Giuseppe Liistro, Published Online:1 Dec 2010https://doi.org/10.1089/jamp.2010.0816


- Drug Delivery Comparison using the Breathing Matters Recovery Concentrator on a Ventilated Human Model, Aerosol Research and Engineering Laboratories, 2016

- Product Classification Analysis: Recovery Concentrator, Biologics Consulting, April 2018

- Personal Experience and Qualitative Observations
Nebulizers

Jet
Compressed air atomizes liquid

Figure 1: Functioning of Pneumatic Jet Nebulizer

Figure 2: Principles of Mesh Nebulizer

Ultrasonic
Sound waves atomize liquid

Figure 3: The Ultrasonic Nebulizer

Vibrating Mesh
Laser drilled mesh vibrates to atomize liquid

Jet Nebulizer

Diagram shows a jet nebulizer with key components labeled:
- Patient interface
- Ambient air in
- Drug loss during exhalation
- Baffle/Orifice
- Dead volume
- Liquid in reservoir
- Compressed gas source
A Few Examples of Jet Nebulizers

T-Neb with corrugated tubing (open system)
Inexpensive, easy to clean and maintain, longer delivery times, noticeable drug loss.

Mask (open system)

Pari LC Jet - Semi closed system – Inexpensive, limited drug loss, easy to clean, short delivery time, superior particle size performance and efficiency, need to replace med cup every 6 months.
A Few Examples of Jet Nebulizer Medicine Cups
Jet Nebulizers Need Compressed Air or Oxygen Source (2 to 10 L/min)

Easy carry, Rx is usually required, noisy, cannot adjust pressure

Not easily portable, RX required, noisy, can adjust flow
Another Option for T-Neb Users

- Breathing Matters - Recovery Concentrator (RC)
- Invented by PAP patient Lloyd Courtney
- Patent number # 9,480,805,B2 – Nov. 1, 2016
- Recovery Concentrator is a Class 1 medical device, accessory to a medical device, and does not require a submission to FDA, 510(k) or PMA, prior to marketing and distribution.
- Tested by Aerosol Research & Engineering Laboratories in 2016 – when tested against a Hudson RCI 8900 T-Nebulizer showed a 251% increase in total drug delivery and 224% increase in total respirable (0.4 to 5 microns) mass delivered.
- Negligible drug loss, fast delivery time, easy to clean and maintain.
Ultrasonic and Vibrating Mesh (Membrane) Nebulizers

- Ultrasonic Nebulizer - uses a transducer horn to create high frequency sound waves that pass through a liquid to produce an aerosol.
  
  ✓ Microair NE-U22 ® (Omron, Bannockburn, IL)

- Vibrating Mesh Nebulizer - use a piezo element that contracts and expands on application of an electric current and vibrates a precisely drilled mesh (membrane) in contact with the medication in order to generate an aerosol.
  
  ✓ Aeroneb ® (Aerogen, Galway, Ireland) and the eFlow ® (PARI, Starnberg, Germany), I-Neb, (Phillips Respironics)

Note – both types use vibrations to produce an aerosol. Some ultrasonic products may be labeled as an “Ultrasonic Vibrating Mesh” nebulizer, which is a little confusing. However, when the term “ultrasonic” is used its primary vibration generator are sound waves, no matter how the product is labeled.
Examples of Ultrasonic Nebulizers

Omron Micro Air ~ $100

Soho Emporium ~ $45
Examples of Vibrating Mesh Nebulizers

Rocket Neb ~$80

Pari eFlow ~$1,300
## Summary Of Pros And Cons Of Different Nebulizer Types

<table>
<thead>
<tr>
<th>Device</th>
<th>Pros</th>
<th>Cons</th>
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<tr>
<td>Jet Nebulizers</td>
<td>Cheapest, easy to use and clean, low maintenance, can handle thicker solutions.</td>
<td>Noticeable drug loss*, longer delivery time, less preferred respirable particle size produced, noisy, needs compressed air or O2, not easily transported.</td>
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<td>*A T-Neb used with a Breathing Matters Recovery Concentrator has negligible drug loss.</td>
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<td>Ultrasonic Nebulizers</td>
<td>Quieter than either Jet or Mesh, faster delivery time than Jet, minimal drug loss compared to Jet, portable.</td>
<td>More expensive than Jet, harder to clean and maintain than Jet, may need to replace parts on a regular basis, should not be used with thick suspended solutions.</td>
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<tr>
<td>Vibrating Mesh (Membrane) Nebulizers</td>
<td>Most efficient at producing preferred respirable particle size, fast delivery time, minimal drug loss, quite, portable.</td>
<td>More expensive than Jet, difficult to clean, higher maintenance requiring regular replacement of components, depending on medication may need to adjust dose to avoid overdosing.</td>
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Closing Thoughts on Nebulizers

- There is a large variety of nebulizers on the market from which to choose.
- Costs vary widely, sometimes even for the same device.
- Costs range from about $30 for a cheaper jet nebulizer up to many thousands of dollars for a high end mesh nebulizer.
- Minimal drug loss is very important.
- Consult with your doctor and fellow patients for recommendations.